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Ralf T. Kreutzer · Marie Sirrenberg

Understanding Artificial Intelligence

Fundamentals, Use Cases and Methods for a Corporate AI Journey

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Any sufficiently advanced technology is not too different from magic.
Arthur Clarke

Preface

One term is increasingly dominating discussions on the subject of digitalization: **Artificial Intelligence (AI)**. Chinese companies such as *SenseTime* even place Artificial Intelligence at the **center of the 4th Industrial Revolution**, in which most of the world's economic nations find themselves today. *SenseTime* has a good position to do this—after all, it is currently the **most valuable AI start-up in the world**.

This is not by chance: In its **master plan "Made in China 2025,"** China defined Artificial Intelligence as one of ten industrial areas in which China wants to achieve a global leadership role. China had defined impressive goals. By 2030, China wants to be more than just a global **AI innovation center**. The Chinese AI industry will then have a value of approx. 150 billion US-$—and the AI-supported industry ten times that amount. China has recognized that Artificial Intelligence is the **mother of all new technologies**.

Developed countries in America and Europe are (still) far away from this kind of strategic planning. Several questions arise regarding the possible causes:

- Is the inadequate analysis with Artificial Intelligence due to the fact that there is still **no comprehensive idea** of what Artificial Intelligence can do for companies, entire industries, and countries?
- Is it primarily the **tight legal framework** that makes it difficult for companies operating in that area to build up and use data necessary for Artificial Intelligence?
- Or is it a **lack of (proven) concepts** to successfully unleash the potential of Artificial Intelligence in the own environment?

We should have in mind that we are already in permanent contact with **AI applications** today. If we use a **digital personal assistant** such as *Alexa* or *Google Home*, we have access to AI applications. Anyone who receives support from *Google Translate* or the German start-up *DeepL* in **translating** will benefit from Artificial Intelligence. Whoever uses **facial recognition** systems utilizes AI algorithms. When radiologists have X-ray images and CT scans evaluated by computers, AI-supported **expert systems** are in action. In addition, **robots** are increasingly being deployed—and not only in production. Autonomous driving is another AI field of application that uses a robot as a driver. This makes it clear:

Artificial Intelligence has already arrived in our everyday lives.

With this book, we want to contribute that (even) more people understand and recognize **the potential associated with Artificial Intelligence**. At the same time, it is clarified which **framework** is necessary **for a responsible handling of Artificial Intelligence**. Finally, a convincing **AI journey for the corporate development of the AI potential** is presented. After all, one thing is for sure:

Artificial Intelligence will change the lives of people and companies—embedded in the possibilities of digitalization—even more sustainably than many can imagine today.

The book encourages to consider this topic seriously (at an early stage) and should help to identify and use sustainable value-adding fields of application—before others do. Above all, it is intended to arouse curiosity and interest in the various fields in which Artificial Intelligence can unfold its effects. It applies:

Artificial Intelligence will very quickly evolve from a nice-to-have technology to a have-to-have technology. After all, Artificial Intelligence is not a technology like many others, but a basic innovation that will penetrate all areas of business and life in the coming years.

It's good to be prepared for that.

Berlin, Germany — Ralf T. Kreutzer
Bad Wilsnack, Germany — Marie Sirrenberg
August 2019

Contents

1 What Is Artificial Intelligence and How to Exploit It? 1
1.1 What Is the Core of Artificial Intelligence? 2
1.2 Which Goals Can Be Achieved with Artificial Intelligence? . . . 14
1.3 Fields of Application of Artificial Intelligence 22
1.3.1 Natural Language Processing (NLP) 24
1.3.2 Natural Image Processing/Computer Vision/Image Processing 30
1.3.3 Expert Systems 34
1.3.4 Robotics/Robots 36
1.4 What Are the Global Economic Effects of Artificial Intelligence? 41
Bibliography 55

2 Basics and Drivers of Artificial Intelligence 59
2.1 Moore's Law and the Effects of Exponentiality 60
2.2 Digitalization and Dematerialization of Products, Services and Processes 60
2.3 Connecting Products, Services, Processes, Animals and People 62
2.4 Big Data 64
2.5 New Technologies 69
2.6 Investment in Artificial Intelligence 81
Bibliography 84

3 Fields of Application of Artificial Intelligence—Production Area 87
3.1 Introduction to the Fields of Application 87
3.2 Significant Developments in the Production Area 88
3.3 Smart Manufacturing 89
3.4 Further Development of the Value Chains and the Value Systems 94
3.5 Effects of Smart Manufacturing and Outlook 96
Bibliography 102

4 Fields of Application of Artificial Intelligence—Customer Service, Marketing and Sales . . . 105
4.1 Service Sector: From Simple Chatbots to Digital Personal Assistants . . . 105
4.1.1 Expectation Matrix of Customers and Companies . . . 105
4.1.2 Voice Analytics and Chatbots in the Service Sector . . . 107
4.1.3 Digital Assistants in the Service Sector . . . 116
4.1.4 Integration of Chatbots and Digital Assistants into Customer Service . . . 125
4.2 Marketing and Sales . . . 130
4.2.1 Lead Prediction, Lead Profiling and Recommendation Engine . . . 130
4.2.2 Conversational Commerce . . . 133
4.2.3 Sentiment Analysis . . . 136
4.2.4 Dynamic Pricing . . . 140
4.2.5 Content Creation . . . 141
4.2.6 Image Recognition . . . 144
4.2.7 Fake Detection . . . 147
Bibliography . . . 151

5 Fields of Application of Artificial Intelligence—Retail, Service and Maintenance Sector . . . 155
5.1 Challenges in the Retail Value Chain . . . 155
5.2 Forecasting Purchasing Behavior in the Retail Sector . . . 158
5.3 Service and Maintenance Sector . . . 161
Bibliography . . . 165

6 Fields of Application of Artificial Intelligence—Health Care, Education and Human Resource Management . . . 167
6.1 Health Care Applications to Improve Standard Processes . . . 167
6.2 Digital Twins and Human Brain Projects . . . 170
6.3 AI-Based Medical Use Cases . . . 173
6.4 AI-Supported Education . . . 179
6.5 AI-Supported Human Resource Management . . . 186
6.6 Summary . . . 190
Bibliography . . . 191

7 Fields of Application of Artificial Intelligence—Energy Sector, Smart Home, Mobility and Transport . . . 195
7.1 AI Applications in the Energy Sector . . . 195
7.2 Smart Home Applications . . . 197
7.3 From Smart Home to Smart City . . . 202
7.4 Mobility and Transportation Sector . . . 205
Bibliography . . . 209

8 Fields of Application of Artificial Intelligence—Financial Services and Creative Sector 211
8.1 Financial Services 211
8.2 Creative Sector 215
Bibliography 223

9 Fields of Application of Artificial Intelligence—Security Sector and Military Sector 225
9.1 Security Sector and Social Scoring 225
9.2 Military Sector 230
Bibliography 233

10 AI Challenge—How Artificial Intelligence Can Be Anchored in a Company 235
10.1 3-Horizon Model as a Framework for Orientation 235
10.2 Recording the AI Maturity of Your Own Company 238
10.3 Development of an AI Journey in the Own Company 242
10.3.1 Phase 1: Comprehensive Information Gathering 242
10.3.2 Phase 2: Systematic Preparation of AI Deployment . . . 245
10.3.3 Phase 3: Development of AI Applications 248
10.3.4 Phase 4: Integration of AI Applications and AI Results into the Company 268
Bibliography 272

11 Outlook 275
11.1 Time Horizons of Possible AI Developments 275
11.2 Challenges for Politics and Society 280
Bibliography 285

Bibliography 287

Index 303

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(2018), *Online Marketing – Studienwissen kompakt* (2nd edition, 2019), and *Toolbox for Marketing and Management* (2019).

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Abbreviations

AAL	Ambient assisted living
AGI	Artificial general intelligence
AGV	Automated guided vehicle
AI	Artificial Intelligence
AIaaS	Artificial Intelligence as a service
AIR	Artificial Intelligence roman
AKI	Acute kidney injury
AP	Associated Press
API	Application programming interface
AR	Augmented reality
BaaS	Backup as a service
BCI	Brain–computer interface
BEO	Bot engine optimization
BKA	Bundeskriminalamt (German Federal Criminal Police Office)
BMI	Brain–machine interface
CFI	Leverhulme Centre for the Future of Intelligence
CPS	Cyber-physical system
CRM	Customer relationship management
CT	Computed tomography
CUI	Conversational user interface
DFKI	Deutsches Forschungszentrum für Künstliche Intelligenz (German Research Center for Artificial Intelligence)
DICaaS	Data-intensive computing as a service
DWH	Data warehouse
EEG	Electroencephalography
EMG	Electromyography
ERP	Enterprise resource planning
ETFs	Exchange-traded funds
EU	European Union
FAQs	Frequently asked questions
FLOPS	Floating point operations per second
fMRI	Functional magnetic resonance imaging
GDPR	General Data Protection Regulation

GDR	German Democratic Republic
GIGO	Garbage in, garbage out
GUI	Graphical user interface
HBP	Human brain project
HPCaaS	High-performance computing as a service
HR	Human resources
HuaaS	Humans as a service
IaaS	Infrastructure as a service
IoE	Internet of everything
IoT	Internet of things
IT	Information technology
ITS	Intelligent tutoring system
KDD	Knowledge discovery in databases
LPWAN	Low-power wide-area network
MaaS	Mobility as a service
ML	Machine learning
MOOC	Massive open online course
MRI	Magnetic resonance imaging
MUaas	Music as a service
MVP	Minimum viable product
NASA	National Aeronautics and Space Administration
NER	Named entity recognition
NLG	Natural language generation
NLP	Natural language processing
NLU	Natural language understanding
NPS	Net Promoter Score
OECD	Organisation for Economic Co-operation and Development
OEM	Original equipment manufacturer
PaaS	Platform as a service
POS	Part-of-speech (tagging)
RFID	Radio frequency Identification
ROI	Return on investment
RPA	Robotic process automation
SaaS	Software as a service
SDK	Software development kit
SEO	Search engine optimization
SLAM	Simultaneous localization and mapping
SST	Self-service technologies
STEM	Science, technology, engineering, and mathematics
STS	Speech-to-speech
STT	Speech-to-text
TaaS	Transportation as a service
TK	Techniker Krankenkasse (German Health Insurance)
TTS	Text-to-speech
TTT	Text-to-text

UX	User experience
VEO	Voice engine optimization
VMES	Virtual manufacturing execution system
VR	Virtual reality
XAI	Explainable Artificial Intelligence

What Is Artificial Intelligence and How to Exploit It?

1

Abstract

In this chapter we discuss the core aspects of Artificial Intelligence. We define the key terms and show the interconnectedness of terms like neural networks, machine learning and deep learning. We analyse the different goals which can be achieved by using Artificial Intelligence. In addition we present the key fields of application of Artificial Intelligence: national language processing, national image processing, expert systems and robots. Also the global economic effects of Artificial Intelligence are discussed. Here you can learn the different starting points and achievements of the leading countries of the world.

Impossible is not a fact! It is an opinion!

Artificial Intelligence is a relatively new field of research that is only slowly emerging from the sphere of specialists. Most of the time it meets us in a way that does not initially make us think of Artificial Intelligence. We only notice that something is easier to do than before. Just think of **digital personal assistants** like *Alexa, Google Home* or *Siri,* which play the desired music from *Spotify* via voice input, create shopping lists or even initiate purchases, set appointments for you, explain terms for you or if necessary, take over the complete control of your Smart Home. We speak of digital personal assistants because they are no longer physically tangible assistants.

When you are using the **translation aids** on the Internet, like *Google Translate* or the German startup *DeepL*, you also have access to AI applications. AI algorithms are also used for **facial recognition systems** (e.g. for access control in companies or for using your smartphone). AI-supported **expert systems** are used for the evaluation of medical records or X-ray images and CT scans by computers. Robots represent an almost inexhaustible field of application for Artificial Intelligence. Their intensive use is no longer limited to production and logistics tasks. Autonomous driving is also an AI field of application that uses a **robot** as a driver.

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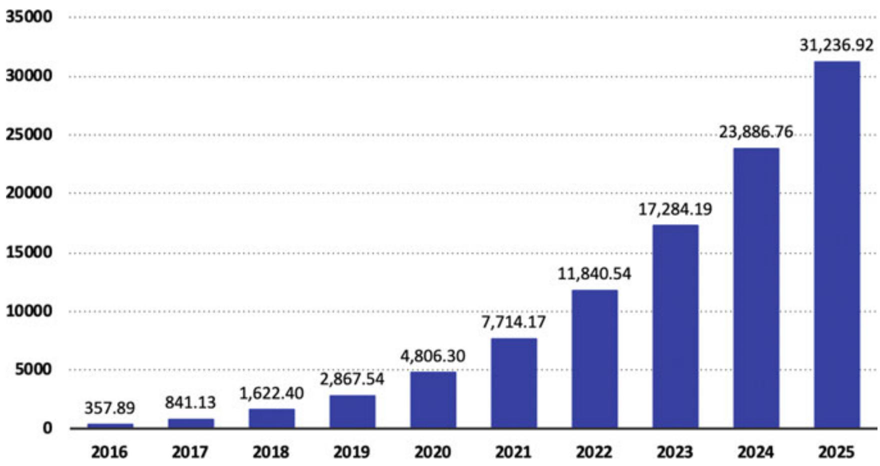

Fig. 1.1 Forecast of turnover with enterprise applications in the field of Artificial Intelligence—worldwide from 2016 to 2025 (in US-$ million). *Source* Statista (2018)

The greatest challenge of Artificial Intelligence is still the comprehensive **reproduction of the human brain**.

Is it worth for you as a student, as a manager, as a company or as a country to deal intensively with the developments around Artificial Intelligence? We are convinced: yes! We would like to underline this assessment with the facts in Fig. 1.1. Here it becomes clear which **revenues from Artificial Intelligence** are expected worldwide from 2016 to 2025 (in US-$ million). In our opinion, these figures speak for themselves!

Before we go more deeply into the various fields of application of Artificial Intelligence, we first clarify what exactly is meant by Artificial Intelligence and which goals can be achieved by it. Then different fields of application are analysed in depth to illustrate the range of AI usability. In addition, we examine the global economic effects triggered by Artificial Intelligence.

1.1 What Is the Core of Artificial Intelligence?

Before we approach "artificial" intelligence, it is worth to take a look at **intelligence** itself. Instead of narrowing one's view and looking at only one intelligence quotient, it helps to understand what **human intelligence** is or can be today. This means that we capture intelligence in its relevant manifestations as a **multiple intelligence** approach that covers the following areas (cf. Gardner, Davis, Christodoulou, & Seider, 2011, pp. 490–498):

- Linguistic intelligence
- Musical intelligence

- Logical-mathematical intelligence
- Spatial intelligence
- Physical-kinesthetic intelligence
- Intrapersonal and interpersonal intelligence
- Naturalistic and existential intelligence
- Creative intelligence

The **diversity of intelligence** already shows at this point why we are still far away from machines that will be able to cover the innate and learned fields of intelligence in their entirety. Therefore, in our opinion, it is not only premature, but also excessive, to concentrate the AI discussion on horror scenarios in which AI machines take over world domination.

Memory Box
Artificial Intelligence (AI) covers two areas. First of all, it includes the research of how "**intelligent**" **behavior** can solve problems. Based on the gained knowledge, systems are developed that (should) automatically generate "**intelligent**" **solutions**. The approach is not limited to work out solutions in a way people would do. Rather, the aim is to find results that lie outside the human solution space. The core of Artificial Intelligence is software!

There are various approaches of conceptualizing the essence of **Artificial Intelligence**. The following very flexible definition by Rich (1983) is, in our opinion, best suited for fundamental clarification. It says, "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better." This identification of Artificial Intelligence makes it clear that the limits of what is feasible are constantly being redefined. Or did you expect 10, 15 or 20 years ago that self-driving cars would appear to be an almost normal phenomenon in 2019?

A more precise definition is: Artificial Intelligence is the ability of a machine to perform cognitive tasks that we associate with the human mind. This includes possibilities for perception as well as the ability to argue, to learn independently and thus to find solutions to problems independently. Three types of evaluations—combined or isolated—can be applied:

- **Description** (description of the "actual")
- **Prediction** (forecast of the "will")
- **Prescription** (recommendation of the "what")

During the development of Artificial Intelligence an interesting **phenomenon** occurred. The first tasks of Artificial Intelligence were difficult for humans, but easy for AI systems to handle (such as complex computing processes). Such tasks could be solved exactly by formal mathematical rules. One of the easiest tasks for AI systems was to work through a large amount of data using these rules. On the other hand, it is often much more difficult for computers to cope with tasks that are easy

to master for people whose solution is not based solely on mathematical rules. This is the case with speech and object recognition. A person can very easily see when a physical object is a table and when it is a chair. Both usually have four legs, but the function is different. To learn this, the AI system often needs to be shown a large variety of images. Nevertheless, this system can often—not yet—recognize the actual “meaning of the objects”.

If an AI system has learned the **difference between a shepherd dog and a wolf** through a large number of photos, the system can easily be misled if a shepherd dog can be seen in a picture with snow. Then it can happen that the shepherd dog is recognized as a wolf, because many wolf photos show snow in the background. Or the other way around: If a wolf wears a collar for the leash in a photo, the AI system will certainly suspect a shepherd dog, because in the training photos for the AI algorithms there were certainly hardly any wolves with a collar. That’s it about the (current) intelligence of computers!

We approach the contents of Artificial Intelligence best via Fig. 1.2. An important element of Artificial Intelligence are the so-called **neural networks**. This term originally comes from the neurosciences. There, a neuronal network refers to the connection between neurons that perform certain functions as part of the nervous system. Computer scientists are trying to recreate such neural networks. A special feature of them is that information in the networks is not processed via linear functions. Here information is processed in parallel, which is possible by linking the neurons and the special processing functions. In this way, even very complex, non-linear dependencies of the initial information can be mapped. It is crucial that neural networks learn these dependencies independently. This is based on experience data (also called training data) which these systems are fed with at the beginning (cf. Lackes, 2018).

A **neural network** is a system of hardware and software whose structure is oriented towards the human brain. Thus, it represents the **masterpiece of Artificial Intelligence**. A neural network usually has a large number of processors that work

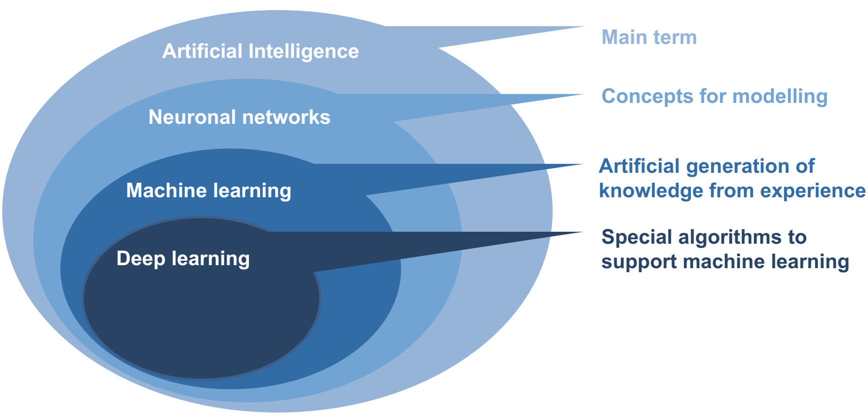

Fig. 1.2 Performance components of Artificial Intelligence (Authors’ own figure)

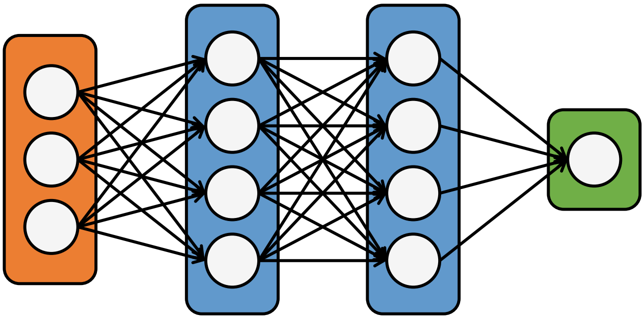

Fig. 1.3 Different layers in neural networks (Authors' own figure)

in parallel and are arranged in several layers (see Fig. 1.3). The first layer (**input layer**) receives the raw data. This layer can be compared with the optic nerves in human visual processing. Each subsequent layer (here **hidden layer** 1 and 2) receives the output of the previous layer—and no longer the data processed in the preceding layers. Similarly, neurons in the human system that are further away from the visual nerve receive signals from the neurons that are closer to them. This natural process is imitated by neural networks. A very large number of hidden layers can be used to process the data—often not just 100, 1000 or 10,000! The AI system learns from each transition to another layer (ideally). The last layer (**output layer**) generates the output of the results of the AI system (cf. Rouse, 2016).

Each **processing node** has its own area of knowledge. This includes not only the rules with which it was originally programmed. Rather, this includes the knowledge and rules that have been developed in the course of so-called machine learning in a supplementary or corrective manner. This means that the "machine" learns on its own and can thus more or less distance itself from the original "knowledge" (cf. Schölkopf & Smola, 2018).

Memory Box

The "machine" increasingly emancipates itself from the original inputs (data and rules) in the course of its use. In comparison to classical rule-based systems (where data is processed as it was defined in advance), Artificial Intelligence tries to develop and learn independently in order to achieve even better results on the basis of the experience gained in this way. The algorithms used initially only represent the breeding ground for the development of new algorithms. If new algorithms are proved to be more meaningful in the course of the learning process, the "machine" continues to work with them independently. This process is called **machine learning**.

In order to support this learning process, the different levels are connected in many ways. As shown in Fig. 1.3, the inputs of each node of a level “n” are connected to many nodes of the preceding level “n − 1”. An exception is the input layer, which can have only one node (Fig. 1.3 shows three nodes here). In addition, the outputs of level “n” are connected to the inputs of the following level “n + 1”. The links described enable information to be passed on step-by-step from layer to layer. The second exception regarding the number of nodes is the output layer. There can be one (as in Fig. 1.3) or more nodes from which answers can be read.

The **depth of the model** is one way to describe neural networks. This is defined by the number of layers that lie between input and output. Here we talk about the so-called hidden layers of the model. Further, neural networks can be described by the **width of the model**. Concerning the width the number of hidden nodes of the model and the number of inputs and outputs per node are taken into account. Variations of the classical neural network design allow different forms of forward and backward propagation of information between layers.

Let us take a closer look at the important **machine learning** (ML). As already indicated, algorithms are used which are able to learn and thus improve themselves independently. An algorithm is a programmed statement that processes input data in a predefined form and outputs results based on it. Machine learning uses very special algorithms—so-called **self-adaptive algorithms**. They allow the machines to learn independently without programmers having to intervene in the ongoing learning process. Large amounts of data are required. Only then the algorithms can be trained in such a way that they are able to master predefined tasks better and better—without having to be reprogrammed for them. For this purpose, insights are accessed which are gained through deep learning (see below). In order to promote these learning processes, large, high-quality amounts of data are therefore required as “training material”. The new algorithms are generated with these so-called **training data**. After completion, these are continuously reviewed with further **input data** in order to improve the basis for decision-making. In order to improve the performance of the algorithm, so-called **feedback data** is needed (cf. Agrawal, Gans, & Goldfarb, 2018, p. 43).

In machine learning and thus in the development of increasingly powerful algorithms, different **types of learning** can be distinguished (cf. Gentsch, 2018, p. 38f; McKinsey, 2018b, pp. 2–6.):

- **Supervised learning**
  In this learning process, the AI system already knows the correct answers and must “only” adapt the algorithms so that the answers can be derived as precisely as possible from the existing data set. Therefore, the goal or task of the algorithm is already known here.
  In this learning approach, people must identify each element of the input data. The output variables must also be defined. The algorithm is trained on the entered data to find the connection between the input variables and the output variables. The methods used include linear regression, linear discriminant analysis and the

decision tree method. Once the training is complete—typically when the algorithm is sufficiently accurate—the algorithm is applied to new data.
The task of such an AI system could be to explain the known prices for different car models by their characteristics (e.g. brand, horsepower, type of engine, features). Here the system learns independently from a completely predefined data set to recognize the relevant explanatory patterns.

- **Unsupervised learning**
The AI system does not have predefined target values for this form of learning and must recognize similarities and thus patterns in the data independently. Consequently, the user is not aware of such patterns in advance; rather, it is the task of the algorithm to recognize them independently. The knowledge gained by the system can therefore also lie outside what was previously "humanly imaginable".
For this purpose, the algorithm receives unlabeled data. In these, the algorithm should independently recognize a structure. For this purpose, the algorithm identifies data groups that exhibit a similar behavior or similar characteristics. Here, the methods hierarchical and K-Means clustering are used.
An exciting task for this is to recognize people in social media (pattern recognition) who are especially susceptible to believe false messages, to comment them positively and to forward them. Here it is possible that this concerns particularly such persons, who like with particularly frequently cat photos or are mostly only actively posting social media content between 10 and 11 pm. Such findings may lie outside what may have been expected by human beings. The US presidential election (2016) and the Brexit vote (2016) show that such applications—unfortunately from our point of view—have already been used.
- **Reinforcement learning**
In this learning process there is no optimum solution at the beginning of the learning phase. The system must iteratively try out solutions independently through a trial-and-error process in order to discard and/or further develop them. This iterative process is driven by "rewards" (for good solution ideas) and "punishments" (for bad approaches). This learning concept is often used when only few training data is available or when the ideal result cannot be clearly defined. It is also applied when something can only be learned from interaction with the environment.
In the course of this learning process, the algorithm makes a decision and acts accordingly. Then it contains a reward if the action leads the machine to approach the target. Alternatively, the system will be punished for moving away from the target. The algorithm automatically optimizes its actions by constantly correcting itself.
This learning variation was used in the competition between the *Go World Champion* and the computer *Alpha-Go* described in Sect. 1.2. Through the simulation of different games against itself and through the experiences "victory" (reward) and "defeat" (punishment) the system could continuously improve its strategies.

Deep learning is a special design of neural networks and a subset of machine learning (cf. Fig. 1.2; cf. Arel, Rose, & Karnowsk, 2010, p. 13; Domingos, 2015; Kelly, 2014, pp. 6–8; McKinsey, 2018b, p. 6). Deep learning is a type of machine learning that can process a wider range of data resources, requires fewer human data pre-processing, and often delivers more accurate results than traditional machine learning approaches. The "deep" refers to the large number of layers of the neural network. Special networks are set up for this purpose, which can receive very large amounts of input data and process them over several layers. In addition, special optimization methods are used which have an even more extensive internal structure than classic neural networks. Here, deep-seated patterns and correlations are recognized that connect the existing data points with each other.

In order to cope with more demanding tasks, computers today can learn from self-made experience and bring new input data into relation to existing data. It is no longer necessary for people to first formally specify these data. The machine gradually learns to assemble complex concepts from simpler elements. The visualization of these correlations can be achieved by diagrams, which consist of a large number of layers and thus attain "depth" (cf. Fig. 1.3). This is why we speak of "deep learning". An example of this is handwriting recognition. Here pixels have to be detected successively and enriched with content. Classic programming makes it practically impossible to recognize a wide variety of handwriting. This requires concepts that learn "by themselves".

Memory Box
AI applications have basic skills in perception, understanding, learning and acting (cf. Bitkom & DFKI 2017, p. 29).

In this context we speak of **neuro computing** (also **neural computing**). These include technologies that use neural networks that simulate the human brain. These are trained for certain tasks, e.g. for pattern recognition in large files. The comprehensive goal of AI applications can be described by the term **knowledge discovery** (also knowledge discovery in databases, KDD). It is about "knowledge recognition in databases." Various techniques are applied for this purpose, which attempt to identify previously unknown technical connections—the so-called core idea—in large data sets. This "core idea" should be valid, new and useful and ideally show a certain pattern. In contrast to data mining, knowledge discovery not only includes the processing of data, but also the evaluation of the results achieved.

Memory Box
To demystify Artificial Intelligence, we could formulate it flatly: The core of **Artificial Intelligence** consists of independently processing large amounts of data, recognizing patterns and leading to descriptions, predictions, prescriptions or even autonomous decisions based on them. AI applications for such tasks are often faster and—depending on the system—also cheaper than human-based processes.

A special feature of neural networks is their **adaptability** within a certain field of application. This means that these networks can change independently and thus continuously evolve themselves. In each case, the gained findings are based on the so-called "initial training" through the training data as well as through the processing of further data. The weighting of the respective input streams is of great importance. The AI system independently weights those data entries higher that contribute to obtaining correct answers.

In order to train a neural network, it is first fed with large amounts of data. At the same time, the network must be informed of how the output has to look like. In order to train **a network to identify faces of well-known actors**, the system has to process a variety of photos of actors, non-actors, masks, statues, animal faces and so on during the initial training. Each individual photo is provided with a text, which describes the contents of the photo as good as possible. On the one hand this can be the names of the actors depicted there, or on the other hand indications that it is not an actor, but a mask or an animal.

By **providing descriptive information**, the model can adjust its **internal weightings**. Thus, it learns to continuously improve its working methods. Nodes A, B and D can tell the node BB of the next layer that the input image is a photo by *Daniel Craig*. On contrary, node C thinks *Roger Moore* is on the picture (e.g. because the photo shows next to the actor *an Aston Martin* used in James Bond movies). If the training program now confirms that *Daniel Craig* is actually pictured on the photo, the BB node will reduce the weight of the C knot input because it made a wrong evaluation. At the same time, the system will increase the weights for nodes A, B and D because their results were correct.

Each node decides independently which inputs are sent from the previous layer to the next layer in which form. To come to these decisions, neural networks use rules and principles. Gradient based training, fuzzy logic, genetic algorithms and Bayesian inference can be used. **Basic rules about the relationships of different objects** in the space to be modelled can be worked out here. A **facial recognition system** can be taught following things (cf. Rouse, 2016):

- Eyebrows are above the eyes.
- Mustaches are under the nose.
- Beards can be found above and/or beside the mouth, on the cheeks and at the base of the neck.
- Beards are predominantly found in men; however, there are also female beards.
- Eyes lying next to each other at the same height.
- Eyes are right and left above the nose.
- The mouth lies under the nose.
- Etc.

This type of rules, which are given to the system during the initial delivery of material (so-called **preloading rules**), can speed up the training and make the model more efficient. They also make **assumptions about the nature of the problem**, which can later prove to be either irrelevant and unhelpful or even wrong

and counterproductive. Therefore, the decision on whether and which rules are to be defined in advance is of great importance.

In addition, we would like to draw your attention to another important aspect: the **fairness of Artificial Intelligence**. People who define preloading rules and feed data into the systems for training purposes are per se biased—that is our nature. Thus, the rules used here as well as the data can show a bias in the sense of a distortion, which affects later evaluations and decision recommendations (e.g. in creditworthiness checks)—without (easily) being recognized.

Memory Box
A major source of error with AI applications lies in: **bias in—bias out!**

An **example from jurisprudence** can impressively demonstrate this danger. In the USA, an AI system should make concrete court rulings. It was trained on the basis of old court decisions. An interesting phenomenon was discovered during use. If you change the skin color of the accused from white to black, the penalty suddenly went up. Here it became clear that prejudices which lay in the old judgments were unreflectively transferred from the AI system to the new legal cases (cf. Hochreiter, 2018, p. 3; in more detail Kleinberg et al., 2019).

In order to prevent such risks due to distortions in the data records, you must **ensure that the training data is balanced**. One way to achieve this is to exchange balanced data sets between companies. In 2018 *IBM* made the data records of one million facial photos available for use in face recognition systems (cf. Rossi, 2018, p. 21). If only European or only Asian photos were used for training purposes of the AI systems, the results would be falsified with regard to a global use. In addition, the responsible **AI programmer team** should have a high degree of diversity (by age, gender, nationality, etc.) so that neither the training data records nor the preloading rules contain (unconscious) stereotypes and prejudices of the programmers.

A study from 2017 shows how quickly such distortions can occur (cf. Lambrecht & Tucker, 2017). Here it was detected that *Facebook* advertisements were played out in a gender-discriminatory manner. These were job advertisements from the STEM sector (science, technology, engineering, and mathematics), which were played out less frequently for women than for men. This unconsciously built-in discrimination resulted from the fact that young women are a sought-after target group on *Facebook*. Consequently, it is more expensive to place an advertisement for them. So if the algorithm had the choice to decide between a man and a woman with the same click rates, the choice fell on the cheaper variant—in this case the man.

Memory Box
In order to avoid possible distortions in your data, you should use different (reliable) data sources. A high degree of diversity in your teams leads—quasi automatically—to the avoidance of prejudices or stereotypes in AI systems that lead to incorrect findings. A **data audit** can provide valuable support here by systematically checking the quality of the incoming data.

Demonstration-based training is an exciting addition or alternative to the **training of robots**. The programming of robots (especially for production processes) is a complex, time-consuming and expensive task that requires a high degree of expert knowledge. If tasks, processes and/or the production environment change, the robots used there must be reprogrammed. So-called ***Wandelbots*** offer a solution here. **Demonstration-based** teaching allows robots to be programmed without having to write new programs. By demonstrating to robots how a particular task has to be performed, the control program learns the necessary processes independently. This allows task experts to teach robots in dynamic and complex environments—without the need for programming skills. This means that new tasks can be learned from the robot in just a few minutes, without specialist knowledge being required. During the learning process, the robot's sensors and, if necessary, other external sensors record the characteristics of the environment that are necessary for the learning process (cf. Wandelbots, 2019).

Memory Box
You should check to what extent it is possible to use demonstration-based training when training robots.

In addition to avoiding incorrect data records, the **transparency of decision-making processes in AI systems** poses a major challenge. Since the AI machine reaches results and decisions independently, the question "Why?" arises for the users and especially for those who are affected. After all, you don't want to entrust your fate to a black box, be it a financial investment decision (keyword robo advisor), the rejection of a loan application or autonomous driving. Rather, you would like to know why a decision was or is made in which way in which situation.

The task here is: **Explainable Artificial Intelligence (XAI)**. This means the attempt to avoid a black box "Artificial Intelligence" and to create a grey box "Artificial Intelligence", which allows at least a partial traceability of results and decisions. The aim is to make the process and the results of the use of AI more comprehensible. We need to distinguish different fields here:

- **Transparency of data**
  Since the quality and "incorruptibility" of Artificial Intelligence stands and falls with the available databases, it should be possible for the interested user to check the databases of the AI application. If distortions or irrelevant populations are identified in these data, the results of the AI system cannot be trusted. It should be pointed out that expert knowledge is often required to critically review these databases; this is usually not possible for laypersons. Certification processes with appropriate test seals for the data used could help here.
- **Transparency of algorithms**
  In AI applications, it is particularly important to recognize which algorithms have been used to achieve certain results. Since the machine learns on its own, this process is not easy to understand. For the acceptance of the AI results, however, it is indispensable to be able to recognize at least the main influencing factors of a

decision (e.g. in a credit rating of customers or in recommending which persons should be addressed for a new offer via a specific channel and at a certain point in time). The willingness to entrust oneself to AI systems stands and falls with such transparency. After all, no one (today) wants to rely on systems and their decisions that are not traceable.

- **Transparency of data delivery**
  The aim here is to prepare the results for the users and/or those affected in such a way that even a person with little mathematical and/or statistical training can understand the knowledge gained—insofar as the results are not automatically used into ongoing processes. It should be possible to understand in an AI-supported credit rating why person A does not receive any credit in comparison to person B. In an AI-supported development of court rulings, it should become clear why a suspended sentence is proposed for the defendant X and why the defendant Y should be imprisoned.

Without **Explainable Artificial Intelligence**, AI applications remain a black box, making a critical analysis of the underlying processes and the results difficult or impossible. Then users cannot understand how a result is achieved—and it is harder to "trust" the results anyway.

Memory Box
Focus on **Explainable Artificial Intelligence** right from the start—even if your AI specialists prefer to do without it. Without a certain transparency about data, processes and results, it will be difficult for you to gain user acceptance for AI applications and their results.

Artificial Intelligence technologies can be differentiated according to their degree of automation. The **five-step model** in Fig. 1.4 visualizes the possible **division of labor between human and mechanical action**. The degree of automation of decisions depends on the complexity of the problem and the performance of the AI system being used. The following examples illustrate which legal, ethical and economic questions are associated with the respective division of labor. In **assisted decision-making**, an AI system supports people in their decisions. This can be an AI algorithm that makes purchase suggestions at *Amazon* or leads to *Google* auto-completion in our searches. The autocorrection in the smartphone is another example of assisted decision making. Many funny and annoying examples make it clear that some users allow the AI system to make autonomous decisions here!

In the case of **partial decisions**, the AI system already relieves the user of decisions (cf. Fig. 1.4). This is the case with search processes on the Internet or in the social networks. Here the user is presented or reserved information according to certain (non-transparent) algorithms. This is how the so-called filter bubble is created, in which everyone lives in their own (illusory) world, which can be more or less distant from reality (cf. Pariser, 2017). The AI-based translation programs available today should also only be used for partial decisions. In a critical analysis

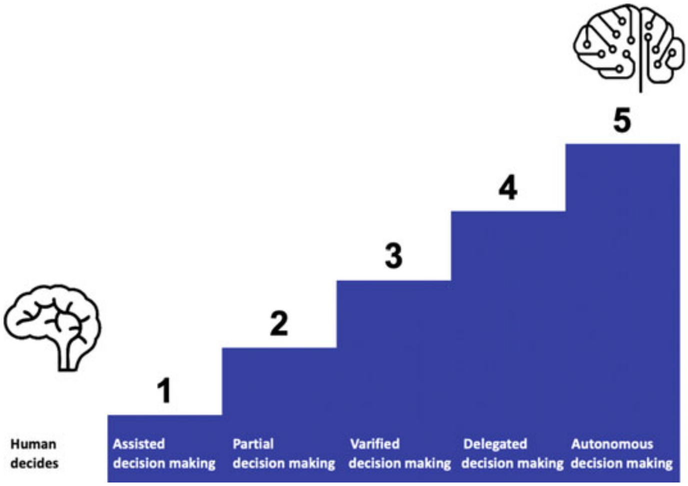

Fig. 1.4 Five-step model of decision automation. *Source* Adapted from Bitkom and DFKI (2017, p. 62)

of the translation results achieved today, many errors can still be detected—especially in more complex texts or dialogs.

During **verified decisions**, individual's decision ideas are reviewed by an AI system—quasi as an application of cross-validation (cf. Fig. 1.4). If the AI system and the human being come to the same result, it must fit. When **delegated decisions** are made, (partial) tasks are deliberately shifted by humans to an AI system. This is often the case with quality controls in production; here, corresponding systems decide independently whether a product meets the quality requirements or not. In **autonomous decision making**, entire task complexes are transferred to an AI system and performed there without further human intervention. This is the case with the robo advisor, which makes independent investment decisions—often in real-time (cf. Sect. 8.1). When driving autonomously, it is already clear from the term that the driver has delegated the entire decision-making responsibility to a robot for controlling the vehicle.

The increasing **delegation of decisions to AI systems** has different consequences. It is of less great relevance if purchase recommendations a customer receives at *Amazon* or *Zappos* are supported by AI alone and thus spread without human intervention. Even translation errors caused by automated systems like *Google Translate* or—much more powerful—*DeepL* will in most cases have no serious impact on life and survival. The situation is completely different with autonomous driving. Here, AI systems must make all decisions in real-time—and this is always about life and death. Even a slight and brief departure from one's own lane can endanger one's own life and that of others (cf. Sect. 1.2 on the trolley problem).

Summary

- **Artificial Intelligence** with its various applications has already arrived in our everyday lives.
- The **facets of human intelligence** are so diverse that it will take many years of development work and high budgets to even come close to human intelligence.
- The applications of Artificial Intelligence are based on the knowledge gained through **neural networks**. The concepts of **machine learning** and **deep learning** are used.
- The information is processed in different layers.
- In order to advance the automated learning process, the forms of learning called **supervised learning**, **unsupervised learning** and **reinforcement learning** are used.
- It must be ensured that the **data for training** the algorithms and the **algorithms initially used are free of distortions**, **prejudices and stereotypes**. Otherwise no "neutral" results can be achieved.
- A major challenge is to make the processes and results of Artificial Intelligence comprehensible. This is the task of **Explainable Artificial Intelligence**.
- Explainable Artificial Intelligence refers to the **transparency of the data used**, the **transparency of the algorithms used** and the **transparency of the delivery of the result data**.
- Creating such transparency is a precondition for the **acceptance of AI systems—** within and outside the company.

1.2 Which Goals Can Be Achieved with Artificial Intelligence?

Humans have always strived to imitate nature and to emulate the solutions found there. The knife was derived from a claw. The birds' ability to fly inspired people to develop a wide variety of aircraft, including the exciting A 380. The fire with its various functions was "domesticate" by humans as a stove, light bulb and heater.

Humans have now set themselves a task that has not yet been solved: the **mechanical reproduction of human intelligence**. The first calculating machines were already being developed in the 17th Century. The Abakus, a mechanical computing aid still partly in use today, is even dated back to the second millennium BC. The development towards the computer did not significantly advance until the 1940s by the German developer *Konrad Zuse*. The *Zuse Z3* and *Zuse Z4* machines were the first universally programmable computers. Already at that time the primary goal was to become equal with human intelligence with the help of technology (cf. Bostrom, 2014, p. 4). Since then, further fundamental breakthroughs have been achieved. In 1997, many people listened attentively when the reigning **chess world champion Garry Kasparov** was defeated for the first time by the chess computer *Deep Blue* of *IBM*.

It then took until 2011 to beat the reigning **champions *Ken Jennings* and *Brad Rutter*** in the knowledge show *Jeopardy*, which was filled with witty language, irony and free association. The winner: *IBM* computer *Watson*. The comment by *Ken Jennings* was exciting: "Brad and I were the first knowledge-industry workers put out of work by the new generation of 'thinking' machines" (Kairos Future, 2015). It is important to understand that it was not only *Watson's* encyclopedic knowledge that lead to win, but also the ability to understand natural language, to recognize irony, to decode abstract statements, to specifically access knowledge and to make quick decisions.

The computer itself responded in natural language; however, at that time it could not yet understand the natural language. Therefore, the quiz questions were transmitted to the computer as text. Algorithms then searched the knowledge archive for words related to the query. *Watson* had online access to *Wikipedia* and the last ten volumes of the *New York Times*. From each of these queries, 50–60 information units were selected, and a ranking was compiled from the maximum of 200 hypotheses. The questions to be answered were about geography, exact dates or even puns. Based on many thousands of *Jeopardy* questions, *Watson* determined which algorithms would best answer which question category. More than 1000 algorithms worked in parallel processes. *Watson* defeated the human geniuses in a field in which—unlike chess—ambiguities, irony and pun are dominating (cf. Heise, 2011).

Then it took another five years until March 2016, when it ended 4:1 for the computer to play the hardest game in the world: *Go*. The reigning ***Go* world champion *Lee Sedol*** from South Korea was beaten by the *Google* software *AlphaGo*. *Lee* lost four out of five games against the self-learning, ever-improving software. Before the game, the world champion was sure of victory. After all, the game of *Go* is much more varied than chess. The playing field does not only have 64, but 361 fields. This results in many more playing possibilities—a challenge for man and machine alike. The world champion had only one—well trained—brain. *AlphaGo*, on the other hand, was able to access two neural networks with millions of connections. The computer could both "think" and predict the most likely features of its counterpart. The highlight was the combination of knowledge with intuition. Deep learning algorithms do not only allow an analysis of thousands of moves. Through trial-and-error, the neural network trained itself to learn from its own experiences—just like a human being, but much faster (cf. reinforcement learning in Sect. 1.1).

After the competition *Lee Sedol* said two things: The computer had surprised him again and again with moves that nobody would make and have never been played before. At the same time, however, he repeatedly had the feeling of playing against a human being (cf. Ingenieur, 2016).

Food for Thought

This victory of Artificial Intelligence in the fight with the *Go* world champion in 2016 was the ***Sputnik* moment** for China to turn to this new technology with full force (cf. Lee, 2018, p. 3). The term *Sputnik* moment plays with the self-conception

of the USA which was challenged by the Soviet Union in October 1957. They had succeeded in shooting the first man-made Satellite named *Sputnik* into space. With the founding of *NASA* (National Aeronautics and Space Administration) in the USA, this triggered a race between the great powers in space at the time, which led to the moon landing by the US-Americans in July 1969.

Until the defeat in the *Go* game, only a few specialists in China dealt with the topic of Artificial Intelligence. The *Sputnik* moment was the end of it. From 2016, a veritable **AI intoxication** set in, making hundreds of thousands of researchers curious about the new technology and motivating the state to make major investments—with considerable progress in this field.

Will there be such a *Sputnik* moment for the USA or Europe, too? If so, how long do we have to wait for this one?

The greatest achievement of today's Artificial Intelligence is to transform existing information of one species into information of another species. This involves translating one language into another, detecting credit card fraud, predicting inventory levels or calculating the best possible real-time route on the road. Whereas around 1990 it was only possible to detect credit card fraud with an 80% probability, by 2000 the figure had already risen to 90–95%. Today it is even 98–99.9% (cf. Stolfo, Fan, Lee, & Prodromidis, 2016; West & Bhattacharya, 2016). The real achievement lies in the increased precision itself. The improved algorithms as well as the higher availability of data enable an improved service in more and more areas of daily life at the same or even significantly lower costs, even when applied to the broad masses (cf. Agrawal et al., 2018, p. 27).

Memory Box

Convenience and low costs are the decisive **drivers for the breakthrough of a technology!**

Food for Thought

Artificial Intelligence can be used very comprehensively and—yes—in a world-changing way. There are—technically—(almost) no limits to the possible fields of application of Artificial Intelligence. The limits should therefore be set by ethical standards. The fact that this can succeed on a global level must be doubted because the previously prevailing and often peace- and wealth-creating multilateralism is increasingly being challenged.

Today, technical efforts are focused on the development of AI technologies that can perceive, learn, plan, decide and act immediately—and often at the same time have to deal with a high degree of uncertainty. Consequently, many AI projects no longer aim solely at imitating human appearance and thinking, as is often the case with basic AI research. Companies are increasingly trying to achieve social and above all economic advantages by using Artificial Intelligence. There are different approaches to the **definition of AI objectives**. A common approach is to divide Artificial Intelligence as follows:

- **Strong Artificial Intelligence**
- **Weak Artificial Intelligence**

This classification was first introduced in 1980 by the US-American philosopher *John Searle* (cf. Searle, 1980, pp. 5–7). **Strong Artificial Intelligence** describes the endeavor to reproduce, optimize and even advance into new performance spheres through a technology in many areas of our everyday life. **Weak Artificial Intelligence**, on the other hand, is already achieved by performing a task on at least a human level—playing chess, providing customers with information or analyzing five million data records in real-time. This is not primarily about imitating human abilities, but about solving complex problems and handling things better than human cognition and physical possibilities allow.

While applications of weak Artificial Intelligence have dominated up to now, researchers are increasingly advancing into applications of strong Artificial Intelligence. It is expected that AI technologies will exceed a critical "mass of knowledge" in the medium term due to their **self-learning ability**. The already described self-learning ability leads to the fact that a system without external support can supplement its knowledge base solely on the basis of the gained experience data, its own observations and conclusions and thus optimize its problem-solving behavior. This will result in a true intelligence explosion leading to a **super-intelligence**—an intelligence that transcends the boundaries of human thought, feeling and action (see Fig. 1.5). Such an intelligence would be the epitome of strong Artificial Intelligence.

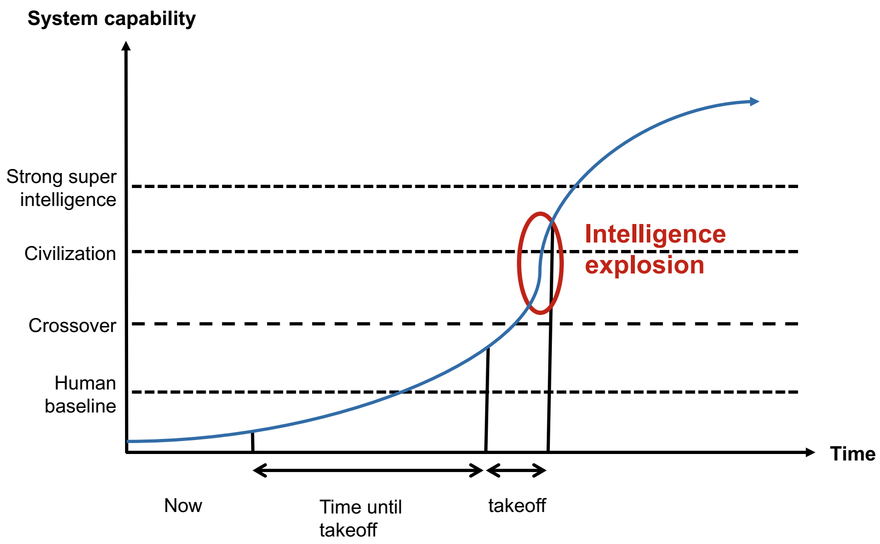

Fig. 1.5 Development to an intelligence explosion. *Source* Adapted from Bostrom (2014, p. 76)

This **super intelligence** will emancipate itself from human intelligence and come to different solutions than humans have thought up so far—based on more data, faster processing and more objective (?) evaluation. Whether these AI-generated solutions will be better or worse than those from human hands can only be decided on the basis of values. This raises a number of questions:

- Who defines the values on which AI systems base their decisions and actions—still human beings or machine itself?
- What are "right" values anyway?
- What would be "justified"—and from whose perspective is this defined?
- What happens when the values of man and machine are no longer congruent?
- In corresponding conflict situations, who decides—if necessary, in real-time—on the relevant canon of values?
- How much longer will human be in charge?
- Will we even be asked—and if so, by whom?

Memory Box

Although there are legitimate reservations about strong AI developments, we must consider the possibility of **developing a super intelligence**. One thing is clear: If a super intelligence will occur, it will have drastic effects on our society!

Food for Thought

Against this background, there is a sentence that the genius *Hawking* (2014) formulated: "AI could spell the end of the human race."

The *Leverhulme Centre for the Future of Intelligence* carries out **fundamental research on the topic of Artificial Intelligence** in this context. The mission is defined as follows (Leverhulme Centre, 2019):

> Our mission at the Leverhulme Centre for the Future of Intelligence (CFI) is to build a new interdisciplinary community of researchers, with strong links to technologists and the policy world, and a clear practical goal: to work together to ensure that we humans make the best of the opportunities of Artificial Intelligence as it develops over coming decades.

The CFI investigates the opportunities and challenges of AI technology. The topics range from algorithmic transparency to the investigation of the effects of Artificial Intelligence on democracy. It is also assumed that in computers—perhaps still in this century—an intelligence is created that corresponds to human intelligence. The aim of the CFI is to bring together the best of human intelligence in order to make the most of machine intelligence (cf. Leverhulme Centre, 2019).

Ray Kurzweil—Director of Engineering at *Google*—expects an **explosion of intelligence** already around the year 2045. It would lead to a giant supplementation of the human brain and thus drastically increase the general efficiency of humans. In extreme cases, could it also mean that we overcome our own biology (including our death) and merge with technology (cf. Galeon, 2016; Kurzweil, 2005)?

Two terms are used in this context: **uploading** and upshifting. Uploading is the (still) hypothetical process by which the totality of human consciousness is transferred to an extremely powerful computer. This transferred consciousness would comprise the entire personality of a person with all his memories, experiences, emotions etc. During uploading, this transfer takes place in one step. **Upshifting** assumes that this process takes place incrementally, i.e. in small steps. For this purpose, the neurons of the brain are gradually replaced by an electronic counterpart. The final result is the same for both processes, only the timespan is different.

The developments described here are called **transhumanism**. It is about the biological expansion of people with the help of computers (cf. Russell & Norvig, 2012, p. 1196). This may sound abstract at first, but let us take a closer look at a medical developments. Technology has always played a major role in medicine. **Prostheses** in any form serve as extensions of impaired body parts and replace destroyed functions. What began with wooden legs, glasses and later pacemakers is now expanding more and more on a neuronal level. The aim is to alleviate the suffering of patients with Parkin's disease, epilepsy or psychological diseases such as depression through interventions directly in the brain. **Neuro-technological implants** are used to stimulate certain areas of the brain autonomously (cf. Krämer, 2015, pp. 40–42; Stieglitz, 2015, p. 6).

Therefore, it can be asked:

- How much transhumanism is already in our current research?
- In what form should we incorporate transhumanism into basic political and economic decisions?
- What effects do such interventions directly in the brain have on the human personality and our society?
- What defines us as human beings?

Food for Thought

The development in the direction of **transhumanism** makes it clear that today's limits of Artificial Intelligence no longer lie in technology. Rather, there is an urgent need for action to clarify the ethical issues involved before technological developments continue to catch up with us! Otherwise, visionary scientists will take the AI wheel—from whichever regions of the world and with whatever value foundation they are equipped.

In addition to the promoters of Artificial Intelligence, there is a large number of **AI critics** who point to the dangers of a comprehensive use of Artificial Intelligence and/or doubt the credibility of strong Artificial Intelligence. These include individual personalities such as *Paul Allen, Gordon Bell, David Chalmers, Jeff Hawkins, Douglas Hofstadter, Gordon Moore, Steven Pinker, Thurman Rodgers* and *Toby Walsh*, but also different institutions all over the world (cf. Allen, 2011; Bitkom & DFKI, 2017, pp. 29–31; Chalmers, 2010; IEEE Spectrum, 2008; Walsh, 2016). They give various reasons why a technological singularity is nothing that

will expect us in the medium term or at all. The term **technological singularity** indicates the point in time at which machines improve themselves by Artificial Intelligence at such a speed that they accelerate technical progress to such an extent that it is no longer possible to predict the future of human and humanity.

Even if it is not foreseeable when which results are to be expected and when or whether a technological singularity will be achieved due to the uncertainties in future AI development, the necessity of **defining ethical goals** remains. A prominent example is the **trolley problem** with autonomous vehicles:

- How should the system decide in a hazardous situation?
- In the event of an unavoidable accident, should it endanger the life of a child?
- Or the death of an elderly couple?
- Or should it drive against the wall and thus risk the life of the driver and possibly other occupants?
- Can we divide human lives into more and less valuable groups and thus decide about life and death?
- Or do we want to use a random generator that takes this final decision independently of the programmer's specifications?

Food for Thought
In this context, it is also spoken of the **death algorithm**; after all, an algorithm will decide who will survive and who will not!

It is interesting to note that higher moral standards are defined for the "machine" than for humans. Because even with people as vehicle drivers there is no binding rule defined how to be decide in such a case.

The answers to such questions can have sustainable **social**, **political**, **ecological and economic implications**. The fact that the mastery of AI technology is not trivial can already be recognized from the fact that people are often no longer able to understand how some AI programs come to their decisions (cf. Explainable Artificial Intelligence in Sect. 1.1). This is because Artificial Intelligence uses different algorithms. On the one hand, the result of a **classic decision tree** can still be easily reconstructed. If, on the other hand, concepts such as **reinforcement learning** or **deep learning** (cf. Sect. 1.1) are used, it is difficult to achieve traceability of the process and result by processing many millions of parameters (cf. Rossi, 2018, p. 21).

Memory Box
The use of AI algorithms increasingly leads to a **trade-off between traceability and precision**. Users must decide whether the traceability of the approach or the accurate results are more important to them. Both are often impossible to achieve together.

If decisions are to be followed—despite a lack of traceability—these AI systems must be programmed with "values" the decisions are based on. But what happens if the AI system determines that the programmed values severely restrict the relevant solution space and prevent a supposedly "best" solution? Can the system develop the values independently and thus change them? Because even the values defined by people on the basis of today's knowledge can be outdated—in view of a much more comprehensive, AI-generated knowledge.

Food for Thought

What would happen if an AI system determined that the survival of planet earth in the long run is only possible with a population of one billion people—or completely without people and their massive intervention in nature? Which decisions should be taken and enforced by whom? Or is already the premise wrong that planet earth should continue to exist—when there are enough other planets (whether animate or not)? Or is it just the further growth of humanity that is the focus—whatever the cost are?

Questions about questions that cannot be answered without a set of values. But who is allowed to develop this framework of values—legitimated by whom?

In any case, the degree to which Artificial Intelligence can decide independently must be defined in the **run-up to AI deployment**, and where the human control instance is indispensable. This is the only way we will be able to define this limit in advance. Or will it continue to shift towards the autonomy of AI systems because we have had good experiences with the results? Can we therefore ever create a safe and pro-human Artificial Intelligence? The use of AI systems by the military at the latest will reach serious limits (cf. Sect. 9.2).

The philosopher *Thomas Metzinger* speaks out against attempts in science to program a consciousness in order to secure our plural society (cf. Metzinger, 2001). *Max Tegmark* founded the *Future of Life Institute* and published a list with hundreds of signatures from science against the development of autonomous weapon systems (cf. Future of Life Institute, 2015). But exactly this is already the case today: AI-controlled drones, which not only carry out the flight autonomously, but also independently recognize and fight targets (people and things). The past is not a bright spot for hope here: Up to now, almost all technological possibilities have been used extensively for military purposes—right up to the atomic bomb.

Food for Thought

- How much autonomy do we as consumers and decision-makers in companies want to grant AI technologies?
- Where do we set the ethical limits for Artificial Intelligence?
- How can we establish that this setting of limits is purposeful?
- What goals are we guided by?
- What values do we base developments on—what is "good" and what is "evil"?

Fictional reading tip
Who is interested in the "history of tomorrow" should take the best-seller of *Yuval Noah Harari* "*Homo Deus*" to hand.

Summary

- **Artificial Intelligence** is not the mere imitation of human intelligence. It also serves to carry out activities that people have not been able to carry out so far, not so quickly and/or not so well.
- A common subdivision of Artificial Intelligence is into **weak Artificial Intelligence and strong Artificial Intelligence**.
- **Weak Artificial Intelligence** has the aim to achieve human abilities on the same or a slightly higher level (e.g. playing chess).
- **Strong Artificial Intelligence** describes the endeavor to achieve human capabilities through the use of technology in almost all areas of our everyday lives.
- The development of strong Artificial Intelligence leads to phenomena such as **super intelligence**, **technological singularity** and **transhumanism**.
- Developments in transhumanism are called **uploading** and **upshifting**.
- Before the development of strong Artificial Intelligence, there is—ideally—a need for a **global ethical agreement** on the use of AI, which will probably never come about.

1.3 Fields of Application of Artificial Intelligence

There is no common approach so far to describe the different fields of application of Artificial Intelligence. Some experts focus on IT-related issues. This results in AI categories such as "machine learning", "modeling", "problem-solving" or "uncertain knowledge" (cf. Görz, Schneeberger, & Schmid, 2013; Russell & Norvig, 2012). In our opinion, such classifications make little sense, because they rather aim at the basics of Artificial Intelligence and not at the exciting areas of use. We see the most important **fields of application of Artificial Intelligence** as shown in Fig. 1.6.

The boundaries between the fields of application of Artificial Intelligence shown in Fig. 1.6 are disappearing more and more. This is illustrated by the example of an autonomous vehicle:

- If the driver enters his destination using a voice command and the car confirms the destination using a natural spoken language such as "The destination Seattle has been confirmed", **voice processing** takes place during input and output.
- An autonomous or semi-autonomous passenger car must continuously process multiple image information from different cameras. This is the only way to recognize red traffic lights, stop signs and speed limits as well as pedestrians, cyclists and other road users. The basis for this is **image processing**.

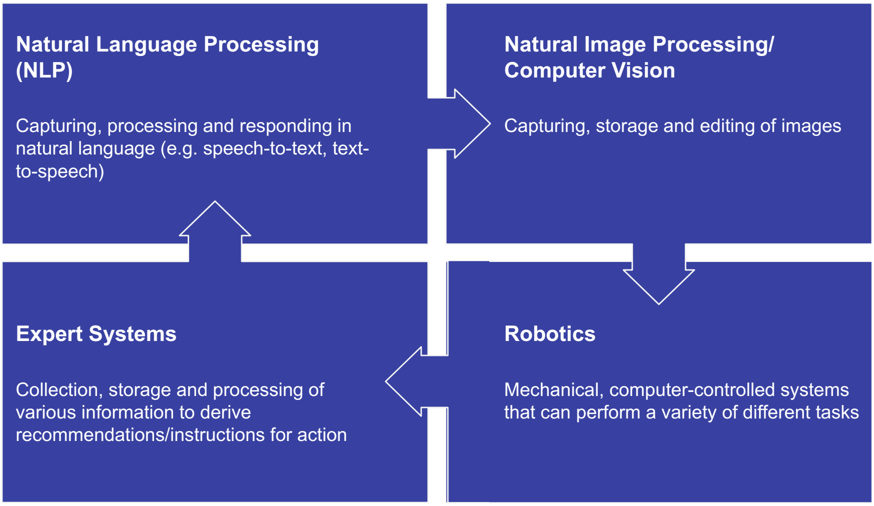

Fig. 1.6 Fields of application of Artificial Intelligence (Authors' own figure)

- During the journey, passengers can find out about the cheapest petrol stations, tourist attractions and interesting restaurants and hotels. **Expert systems** are used for this.
- After all, the entire vehicle with its integrated technologies (including voice and image recognition) represents a particularly powerful **robot**. It has the task of transporting passengers and/or things safely and economically from A to B.

As a result, many AI applications today already represent mixed forms of the fields of application of Artificial Intelligence presented here.

Memory Box
Artificial Intelligence is a cross-sectional technology—just like computers, automobiles, telephones and the Internet. Therefore, AI applications will penetrate all industries and all stages of value creation, sooner or later, more or less comprehensive.

Deloitte (2017) found out which of the fields of Artificial Intelligence defined in Fig. 1.6 dominate today through a worldwide survey of 250 AI-oriented executives. Figure 1.7 shows that **robot-supported process automation** is the most common form. **Voice processing** comes second, followed by the use of **expert systems** and **physical robots**. **Image processing** was not mentioned in this study. In our opinion, the areas of machine learning and deep learning neural networks mentioned in Fig. 1.7—as already explained above—do not represent independent fields of application, but rather form the basis of AI usage.

Below, the individual fields of application of Artificial Intelligence are examined in more detail.

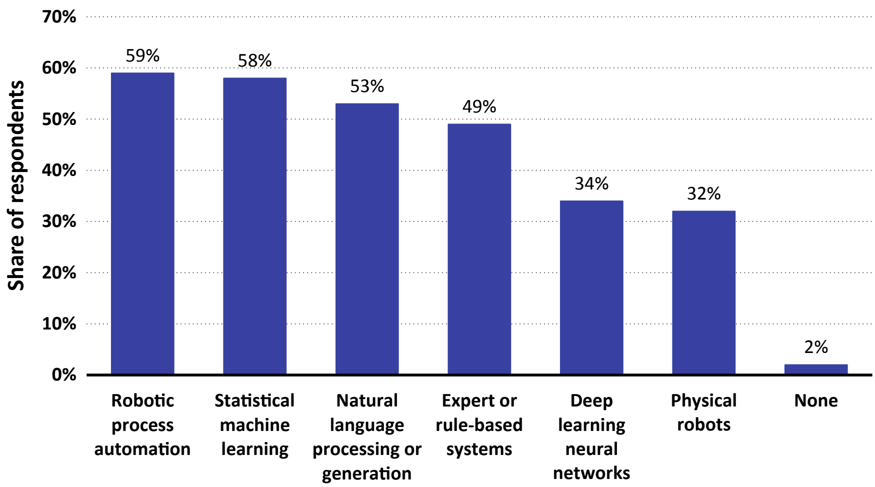

Fig. 1.7 Status quo of the use of Artificial Intelligence 2017—worldwide. *Source* According to Deloitte (2017, p. 6)

1.3.1 Natural Language Processing (NLP)

Natural languages are those spoken by people. To be distinguished from this are the programming languages, such as Java or C++. **Natural language processing** (NLP) or **speech recognition** deals with computer programs that enable machines to understand human speech, both spoken and written. This is a specific form of automated pattern recognition called **linguistic intelligence**.

Figure 1.8 shows the **importance of speech recognition** in the future. Starting from 2018, a five-fold increase in revenues is expected by 2021. These are good reasons for you to be familiar with these fields of application today.

We have to distinguish the following **types of application of natural language processing**:

- **Speech-to-Text (STT)**
  In this application, the spoken word is converted into a digital text. This is the case with the application of *Siri* (*Apple*), if e-mails or notes are dictated directly into the smartphone.
- **Speech-to-Speech (STS)**
  Such an application is available at *Google Translate*. Here a speech input in English is immediately translated into a Japanese or Chinese speech output. The so-called natural language generation (NLG) is used for the output of language. While using digital personal assistants (such as *Alexa* or *Google Home*) question and answer sequences also use this variant. More precisely, it should be called: STT—Processing—TTS. Because the digital assistants first convert the spoken language into a digital text, interpret and process it, generate a digital text as an answer, which is read out linguistically—and all this in a few seconds!

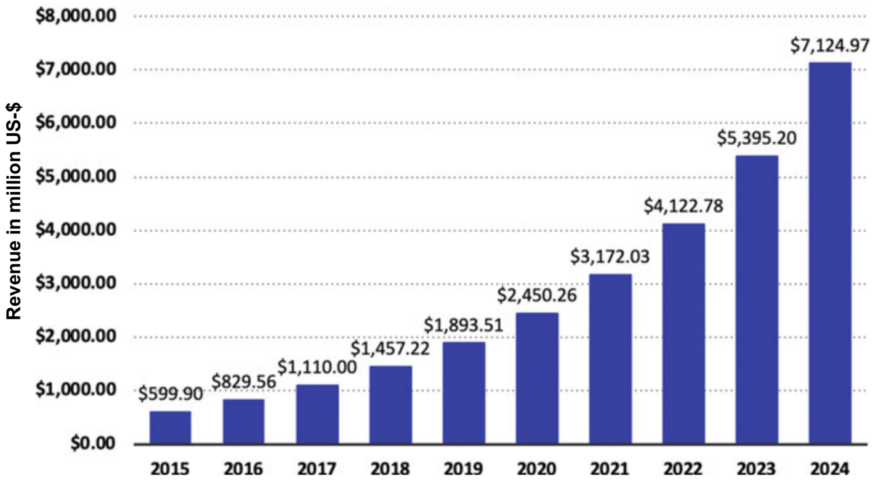

Fig. 1.8 Forecast of global speech recognition revenue—2015–2024 (in million US-$). *Source* Statista (2018)

- **Text-to-Speech (TTS)**
  This application creates a spoken version of the text based on digital documents. E-mails, SMS and other content can be "read aloud" in this way. Acoustic announcements in speech dialog systems also belong in this category. This function can be particularly helpful for visually impaired people, who can thus "read" screen information.
- **Text-to-Text (TTT)**
  In TTT applications, an electronically available text is converted into another language—also in text form—using a translation program such as *DeepL* or *Google Translate*.

For AI systems it is a special challenge to process this kind of data. The reason is caused by the fact that each person has **an individual oral and written form of expression**. This consists of an individual mix of dialect, accent, vocabulary, phonology, morphology, syntax, semantics and pragmatics (cf. Nilsson, 2010, pp. 141–143). NLP applications have to be able to understand the "true" meaning of a statement—as a human brain does (though not always correct!)—despite the differences in all these areas. If wit, irony, sarcasm, puns and rhetorical phrases are used in communication, it results in a still difficult data dilemma for many AI systems.

The AI process responsible for processing spoken language is called **natural language understanding (NLU)**. The special challenge lies not only in the pure sense of a sentence, but also in the multi-layered meaning that can be associated with it. This can be illustrated by the example of the so-called **four-sides model** (**four-ears model**, also called **communication square**; cf. Fig. 1.9). Each verbal message can contain four different kinds of information:

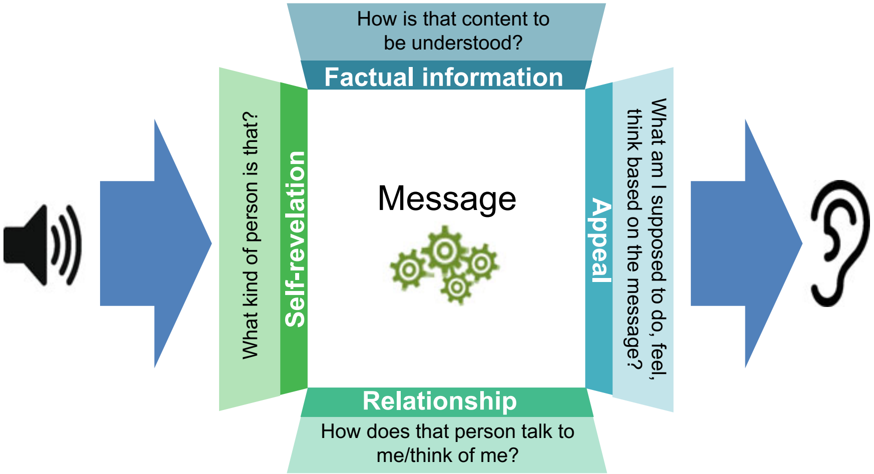

Fig. 1.9 Four-sides model—the four aspects of a message. *Source* Adapted from Schulz von Thun (2019)

- **Factual information**
  This is about the specific, the "pure" information of a statement.
- **Self-revelation**
  With a message, the sender simultaneously transmits—intentionally or unintentionally—information about himself, which he or she wants to share with the other person—or not.
- **Relationship**
  With the terms and the type of emphasis we use, we also "reveal" something about how we think about the other person and how we relate to that person.
- **Appeal**
  Often, a message also contains a request or invitation addressed to the other person.

It is therefore not clearly defined how a recipient processes our message. Our conversation partner listens potentially with all four ears and decides—subconsciously or consciously—which dimension he or she (want to) hear out of a message.

Memory Box
Many **misunderstandings in everyday communication**—private and professional—are due to the fact that we are usually not aware of all **four aspects of a message we send or receive**. Misunderstandings are a logical consequence—but avoidable!

A well-known example illustrates this. Imagine the following situation: She sits at the wheel of the common car, he in the passenger seat. Now he says, "The traffic

light's green." What can be heard depending on the quality of the relationship and the experiences made between the two protagonists so far?

- **Factual information**: The traffic light is green. We can drive!
- **Self-revelation**: I am much more qualified than you to drive a car, because I have already noticed that the traffic light is green!
- **Relationship**: I always have to tell you what to do!
- **Appeal**: Just drive!

The durability of the assumed relationship between the two persons depends largely on which of the four ears is used to receive the message and interpret it accordingly.

Memory Box
Use the **four-sides model** for a few days in your professional and private life—and recognize which misunderstandings occur when we are not aware of the different dimensions of our communication. Here we can only get better! So we can clarify —in the case of unexpected reactions from the other person—what kind of message we "actually" intended to send (e.g., that the traffic light shows "green").

An AI system must also develop the **ability of the four-sides model**—which is not even comprehensively developed in humans—if it is to become an empathetic, compassionate conversation partner. Many applications are still far away from this, as we can experience in many applications day by day.

Figure 1.10 shows everything that belongs to the **natural language processing** topic. Here the term **natural language understanding (NLU)** appears again. NLU is a subset of NLP. Functions that go beyond pure speech understanding or pure speech reproduction are assigned to the NLP area.

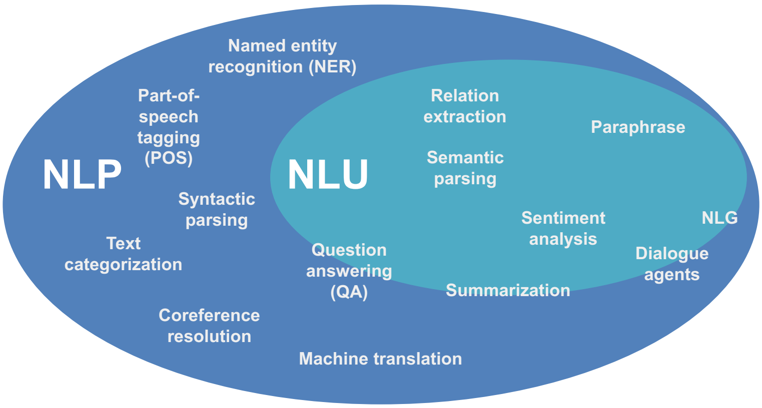

Fig. 1.10 Functions within national language processing. *Source* Adapted from MacCartney (2014)

Natural language understanding refers to the decoding of natural language, i.e. the mechanical processing of the information input that is present as text or spoken words (cf. Fig. 1.10). This is done by **semantic parsing** or extraction of information. **Semantics** deal with the meaning of linguistic signs and sequences of signs; it is about the meaning and content of a word, sentence or text. The term **parsing** stands for the breakdown or analysis. Evaluation by semantic parsing makes it possible to understand individual words or sentences.

Paraphrase is also used for this purpose (see Fig. 1.10). This means the transcription of a linguistic expression with other words or expressions. It is necessary to transform natural language information into a machine representation of its interpretation. The **relation extraction** captures the content of texts and analyses multiple references within sentences in context. If press officer *Martin Miller* of *Capital Inc.* answers journalists' questions in a text, this means that *Martin Miller* is an employee of Capital Inc. or at least acts on their behalf.

A **sentiment analysis** is used to identify specific information from voice messages (cf. Fig. 1.10). A distinction is often made between positive, neutral and negative moods. Thus, it can be derived from *Twitter* comments whether the twittering person is rather critical, neutral or positive towards a politician, a party and/or certain political projects. The same can be done with regard to brands, managers and companies.

Together, these analyses form the basis for a comprehensive understanding of the transmitted voice message in order to generate information based on it. **Dialog agents** are used for this purpose. In addition to digital personal assistants (such as *Alexa, Bixby, Cortana*, *Google Assistent, Siri* & Co.; cf. Sect. 4.1.2), dialog agents are increasingly implemented to provide customer support. All input-output variants of text-to-text, text-to-speech, speech-to-text or speech-to-speech as well as their combinations within a dialog are possible. Here again the **natural language generation** (NLG) is used.

The transition to NLP begins where an initial interpretation of the language is required, such as **answering questions** or **writing summaries** of texts (cf. Fig. 1.10). The exact delimitation is—as so often—fluent. The strongest form of summary is **text categorization** that summarizes the entire content in one word or phrase. This will be shown by the meaning of customer feedback. One statement could be: "The headphones were far too expensive!!! I've never seen such a bad processing before, and the plug is already broken." The comment can be assigned to the category "price" by the keyword "expensive". However, as in this case, it often makes sense to make multiple assignments. The categories "product" (by the term "headphones") and "quality" (recognizable by the terms "processing" and "broken") are also addressed in this example. With many thousands of comments that an online retailer receives, the evaluation is made much easier when these categories are defined.

The translation of a text into another language also requires a comprehensive interpretation by NLU. In addition, further methods of analysis should be used. **Syntactic parsing** is applied here. In contrast to semantics, **syntax** is the teaching of how sentences are formed, i.e. how words and groups of words are usually

connected in sentences. Consequently, the grammatical structures of a text are analysed and used here to represent a context-free relationship between the individual word elements. The term **parsing** stands for the breakdown or analysis. Through the joint evaluation by semantic and syntactic parsing, it is now possible not only to understand individual words or sentences, but to deduce the entire content, process it and generate responses.

In addition, **part-of-speech tagging** (POS-tagging) is used. **Part-of-speech** means annotation or addition. Specifically, in the context of natural language processing, this means that words or entire texts are accompanied by supplementary explanations or additional information in order to increase understanding. This is intended to exclude ambiguities. This type of addition can be explained by the following example sentence: "The woman works in the company". The corresponding annotations are as follows:

- "the" (annotation: specific article, singular)
- "woman" (annotation: noun, female, singular, nominative)
- "works" (annotation: finite verb, present tense, 3rd person singular, in-dicative, derived from the basic form "work")
- "in" (annotation: preposition)
- "the" (annotation: specific article, singular)
- "company" (annotation: noun, singular)

Another method in connection with information extraction is **named entity recognition** (NER). Here the system tries to identify all proper names, such as first names, surnames, brand names, company names etc. and to assign them accordingly. If this succeeds, the author team "Kreutzer/Land" is not incorrectly translated from German to English with "Kreutzer/Country", my hometown "Königswinter" won't be translated in "Royal winter" by a translation program (as happened in test runs) and "Mark Zuckerberg" will no longer be incorrectly translated as "Mark Sugar Mountain"!

In the further processing of a text, the **coreference resolution** determines which words belong to the same entity (i.e. a unit) in order to make a corresponding assignment. An example can illustrate this: One sentence talks about "*Audi*". Then follows the sentence: "The company can look back on a long tradition of automotive engineering in which it has been able to grow in the long term". In this case, "company" and "it" belong to the entity "*Audi*". This assignment is an important basis for a deep understanding, which is necessary for NLU.

Memory Box
NLP programs analyse the text for grammatical structures, assign words to certain word groups or make other superordinate assignments that go beyond the actual content of the text. NLU deals—as a subset of it—with the pure content decoding of the text or the spoken words. Only the interaction of the different analysis steps enables a comprehensive understanding—as a basis for a successful communication.

The aim of NLP applications is to enable machines to communicate with people via natural language. In addition to **human-machine communication**, corresponding programs today also enable improved **human-human communication** by enabling speech, writing and/or reading disabled people with AI systems.

Today, **chatbots** (also known as bots or voice agents) are increasingly used to take advantage of the described AI functionalities. We should distinguish two variants:

- **Text-based dialog systems (TTT)**
- **Language-based dialog systems (STS)**

The first variants of chatbots were **purely text-based dialog systems** (TTT), which allow chatting between a person and a technical system. For this the chatbot offers one area each for text input and text output in order to communicate with the system in natural, written language. An avatar can be used. An avatar is an artificial person or graphic figure that can be clearly assigned to the virtual world. Most users are familiar with such figures from computer games. In the context of chatbots, these are virtual helpers who are supposed to make communication with the system "more natural" (cf. also Sect. 4.1.2).

A subset of chatbots are **social bots**, which are active in the social media and operate there from an account. There they can create texts and comments, link and forward content. If they enter into direct dialog with users, their functionality corresponds to that of chatbots. If these social bots present themselves as real people, they are fake accounts with fake user profiles. Social bots can also identify themselves as machines (cf. *Microsoft's Tay* example in Sect. 4.1.2). Social bots analyse post and tweets and could automatically become active if they recognize certain hashtags or other keywords defined as relevant. In this way, social bots can reinforce content (text and image) circulating in the social media and thus—depending on the assessment—have an economic and political manipulative effect (cf. Bendel, 2019).

Chatbots, which are designed as **speech-based dialog systems** (STS), rely on speech for input and/or output—no longer on texts. This makes communication with a chatbot more and more similar to direct verbal communication. Such systems are used most extensively in the form of digital personal assistants, who have started their campaign of conquest as *Alexa, Bixby, Cortana, Google Assistant* and *Siri* (cf. in more detail Sects. 4.1.2 and 4.1.3).

1.3.2 Natural Image Processing/Computer Vision/Image Processing

Image processing (also known as natural image processing or computer vision) is the processing of signals that represent images (cf. Fig. 1.6). This mainly includes photos and video content. The result of image processing can be either an image or a data set that represents the characteristics of the processed image. The latter is

referred to as **image recognition** (also known as machine vision). This image recognition can refer to still images (photos) and moving images (videos). In a subsequent step, the image information is processed in order to initiate decisions or further process steps (cf. Beyerer, Leon, & Frese, 2016, p. 11). This is also about a specific form of automated pattern recognition, which is called **visual intelligence** here. This form of image processing is different from **image processing**, in which the content of the images themselves are modified (e.g. using *Adobe Photoshop*).

An **evaluation of images** (photos and videos) is available when people are to be recognized in images. The process of image recognition is called **tagging**. It is used on *Facebook*. This makes it possible for users to be automatically recognized in photos and videos uploaded to *Facebook* without having been marked by others. For this task, *Facebook* accesses the profile pictures of the users as well as photos on which the persons have already been clearly marked. Based on this data, a so-called **digital identification mark** is created, which then runs as a search grid over existing or newly uploaded image material. Through this approach, *Facebook* continues to receive relevant data about the connection between users (User A and B; User A, C and G) and their respective activities (alone in Thailand, together at a party, hiking, on the beach, on the Chinese Wall, etc.). As big data gets bigger, *Facebook* knows us better and advertising becomes—supposedly—more relevant and therefore more expensive to sell! We can actively decide whether and to what extent we want this.

Image recognition is also used to find similar images that resemble a template. This application can be found at *Google Reverse Image Search*. Several tests deliver more or less convincing results. It shows that the level of performance has still room for improvement. A result of an image recognition of *Microsoft* is not really convincing, too. A photo showing a cleaning mop in front of a yellow bucket was evaluated as follows: "I am not really confident, but I think it's a close up of a cake." (cf. Voss, 2017). This raises the question of the extent to which we can trust image recognition in self-driving cars if such errors still occur today. And: They're not the only ones.

How can such **blatant misrecognitions** happen? It is quite simple: The algorithms used today are trained by hundreds of thousands of images that show different objects and are provided with corresponding descriptions. However, the systems do not understand the "meaning" of the object on the photo as such but focus on a pure pattern recognition. That is why it is difficult for AI systems to distinguish a table from a chair. If a table then lies upside down on the tabletop, it becomes even harder.

An almost unsolvable task can be seen in Fig. 1.11. For an AI system it is (still) an impossible task to distinguish between a Chihuahua and a muffin. The human intellect, on the other hand, can distinguish a living being from a pastry in a very simple way, because human intelligence recognizes more than just schematic patterns in the images.

Fig. 1.11 Dog or muffin? (Authors' own figure)

Memory Box
The **limits of image recognition in AI systems** are (still) determined by the fact that only visual patterns are compared with each other. The meaning behind the patterns remains (at least at the moment) hidden from the systems.

Our thinking and our natural intelligence are also based on the fact that we can recognize the essence of a thing and distinguish it from its surface. Our perception therefore goes beyond the superficial impression, because we associate further content with the visual impression (cf. Hofstadter, 2018, p. N 4).

Here is a simple example: If we see a pair of underpants carved out of wood, we realize quite naturally that it cannot be a usable piece of laundry—due to the lack of wearing comfort. We would rather see it as a sculpture. An AI system will easily recognize—a "wooden underpants".

The reason for this is simple: Algorithms approach such tasks different as humans, because they lack a "**model of the world**" as a generic pool of experience. What the AI systems do not (yet) show is body awareness and an intuitive understanding of physics. We humans learn this in the course of our socialization "by the way". Therefore, we often only need one single touch point with an object (one training session) to recognize an animal safely. Intuitively we compare the new object with our first experience: a body with four legs, fur and snout? That must be an animal! Easy for us, but still extremely hard for AI systems (cf. Wol-fangel, 2018, p. 33).

Memory Box
AI systems today still lack the ability to create a **symbol of a higher level** (cf. Malsburg, 2018, p. 11). Such a symbol of a higher level is, for example, the image that is created within us when we think of Easter Sunday morning. This image is composed of a multitude of stored memories:

- Experiences (futile Easter egg search in the garden)
- Pictures (a beautifully set breakfast table with daffodils)
- Smells (a wonderful roast lamb)
- Tastes (such as the colorful sugar eggs)
- Sounds (the chimes of the city church)
- Feelings (when touching a *Steiff* Easter Bunny)
- Moods (as in the recitation of Goethe's Easter walk "Liberated from the ice…")

The complexity of linking these very different impressions of meaning in the trigger word "Easter" cannot be achieved by any AI system today! We humans can do that —without any effort!

Systems for image recognition are also used in other areas, e.g. for **admission control for employees** in companies. The Chinese Internet company *Cheetah Mobile* has been using such a facial recognition system for some time (see Fig. 1.12).

The already cited **most valuable AI startup in the world**—the Chinese company ***Sensetime***—has cameras installed throughout the building for demonstration purposes. They enable continuous monitoring of visitors. Further data can also be fed in here in order to describe the persons more precisely.

Fig. 1.12 Face recognition as admission control at *Cheetah Mobile*, Beijing (Authors' own figure)

Fictional reading tip
Anyone who would like to see in an exciting way which consequences are connected with a comprehensive video recording for each individual and society as a whole should read *Dave Eggert's* book "*The Circle*", which is very much worth reading. The movie of the same name with *Emma Watson* is also good; but the book is better in our opinion.

The transition to the **evaluation of video recordings** is fluent—a field of application that is also being massively promoted in China. It is not just a question of distinguishing pedestrians from cyclists and vehicles. The defined objective is to further advance the recognition of video views in order to contribute to crime prevention (e.g. through predictive policing) and to support the recording of crimes through intelligent real-time data analysis (cf. Sect. 9.1).

1.3.3 Expert Systems

Expert systems are computer programs that support people in solving complex problems—like a human expert (cf. Fig. 1.6). For this, the programs derive **precise recommendations** for action on the basis of the given knowledge base. For this purpose, the systems have to be supplied with a multitude of information. At first, the basis is formed by if-then relationships through which human knowledge is made comprehensible for computers. Through the use of Artificial Intelligence, expert systems that have been in use for many decades, could be decisively further developed. In the next few years, we will see very large leaps in development here.

We should distinguish the following **components of expert systems**:

- **Knowledge acquisition component**
  This component involves building and expanding a knowledge base in order to make decisions on a given database. The challenge is to "tap" the data streams from big data sources and to provide only relevant information for decision support. An exciting task for the acquisition of knowledge is the derivation of the educational status of social media affine users on the basis of social media posts.
- **Component for the development of problem solutions**
  The solution-oriented evaluation of the knowledge base can use various approaches. On the one hand, a development in the future forecasted based on the available data. Here we speak of a **data transmission** or a **forward chained approach**. This concept is applied by robo advisors in the financial sector. On the other hand, an identified stage of development can be "recalculated" in order to recognize what the triggers were. In this **event-induced or backward-linked approach**, hypotheses can be formed about the course of already completed processes (e.g. in the case of global warming). Based on the knowledge gained in this way, decisions and decision recommendations can be generated (e.g. with regard to the extent of "acceptable" global warming).

- **Component for solution communication**
  A decisive component of an expert system is the "output function". This is about explaining the solutions found by the system to the user. The quality of this explanation represents an important acceptance criterion for the presented solutions, because hesitate to follow an incomprehensible recommendation (cf. Explainable Artificial Intelligence Sect. 1.1). In the example of global warming the challenge is to prepare the findings in such a way that they can actually be understood by interested persons.

It is easy to see why such expert systems are so important in the context of Artificial Intelligence. AI-supported systems can—based on a certain initial constellation of knowledge—independently learn new things and thus expand the **human horizon of knowledge**. This additional knowledge can be made directly accessible to human beings via expert systems. By proposing certain recommendations to human users, they can apply them directly. The knowledge gained can be made accessible indirectly, too. Then the knowledge gained through expert systems—without human intervention—flows into ongoing processes. We find example quality assurance within production processes (cf. Chap. 3) or in logistics (cf. Sect. 7.4). Expert systems are also used for the evaluation of X-ray and CT images (cf. Sect. 6.1). We find expert systems also in self-driving cars (cf. Sect. 7.4).

Expert systems are also applied in **creative processes**. For this purpose, appropriately configured systems can analyse all *Beethoven* symphonies. Based on thus gained knowledge about the compositional approaches the 10th *Beethoven* Symphony can be composed which actually sounds like *Beethoven*. No fiction—but (imminent) reality (cf. Sect. 8.2).

In the future, **access to powerful expert systems** will become increasingly possible for "normal" users. Here, so-called (digital) **self-service technologies** (SST) are used. A simple application of this kind underlies every *Google* search query. The translation aids from *DeepL, Google Translate, Skype* & Co. also use corresponding expert systems for **text-to-text** and **speech-to-speech** translation in real-time.

Food for Thought
All too often, we only make **good enough decisions** in our daily lives and in our working environment (cf. Agrawal et al., 2018, p. 110). Why are there huge waiting halls at the airport? You have to provide the travelers with a place to wait. The reason for their waiting is an **information gap**. This has to be compensated by a **time buffer** for each individual traveler. Due to an insufficient connection of different information, **just-in-time travel** is not possible today. We lack information about the following aspects:

- Availability of taxis at the starting point
- Traffic conditions on the feeder roads (for your own car, for a taxi or for bus)
- Extent of unpunctuality and unreliability of railway companies
- Parking conditions at the airport

- Shortest routes on the airport premises when travelling
- Length of the queues at the baggage claim area and security controls
- Real boarding time of the booked flight

That is why we have to plan for buffer times if we do not want to miss our flight. Maybe in four or five years an autonomous vehicle will pick us up at the latest possible time and take us to the airport without ever missing a flight—without any stress! For this purpose, the relevant information streams need to be connected in a traffic expert system. Therefore, AI systems we will—hopefully—have to make fewer and fewer good enough decisions in future on the basis of an inadequate database.

1.3.4 Robotics/Robots

The term **robot** describes a technical equipment that is used by humans to perform work or other tasks—usually mechanical work (cf. Fig. 1.6). We can distinguish the following robot types, whereby the separation between the individual categories are not always easy.

Classification of robots according to fields of application:

- **Industrial robots** (e.g. in the automotive industry)
- **Medical robots** (e.g. for performing operations)
- **Service robots**
  - Business assignment (including check-in at hotels and airports)
  - Private use (e.g. vacuum, window cleaning, weeding or lawn mowing robots)
- **Exploration and military robots** (e.g. to detect the surface of Mars or to defuse mines and unexploded ordnance; also used as drones)
- **Toy robots** (e.g. *Vernie*, the *Lego* robot, *Thinkerbot* or *Cozmo*)
- **Navigation robot** (e.g. for autonomous driving)

Classification of robots according to their degree of mobility:

- **Stationary robots** (integrated in production lines, e.g. in automobile production)
- **Mobile robots** (e.g. for logistics processes involving delivery by drones or for self-controlled use as mowing robots)

Classification of robots according to the degree of their interaction with humans:

- **Classic robots** (work independently of humans; are often located in fenced areas so that humans are not harmed by robots)

- **Cobots/collaborative robots** (can work with humans "hand in hand" because the robots recognize the humans and act accordingly "cautiously")

Classification of robots according to the degree of their "human appearance":

- **Machine-like robots** (look and act like machines)
- **Humanoid robots** (look like humans and approach humans more and more in their behavior)

Food for Thought
In recent years, the **motor skills of robots** have already improved enormously. Nevertheless, it will probably still take decades for robots to independently clear out the dishwasher and correctly distribute the cleaned objects into the cupboards. If at all!

The **basic components of robots** are comparable in their different manifestations and are structured as follows:

- **Sensors for the detection of the environment**
  Robots are equipped with different sensors with which they can detect their environment. The environment can change, and the robot perceives this accordingly. This perception can be applied to the next workpiece to be machined or to a drop in pressure at turbine "13". Sensors can help to detect and interpret movements, e.g. to interact with people. Finally, the spoken language can give direct instructions to the robot.
- **Set of functions**
  Depending on the degree of complexity of the robot, it can only perform "hard-wired" functions (e.g. setting 24 welding spots or painting a car body). Or the robot is equipped with machine learning and can learn for itself to further increase the efficiency of its use.
- **Movement components**
  Simple industrial robots are firmly anchored and separated from humans by a cage, because robots might not detect people and might injure them. Further developed robots (e.g. in logistic applications) can navigate independently through warehouses, climb stairs and avoid obstacles if necessary.
- **Interaction with the environment**
  For interaction with the environment, gripping arms and similar devices may be available to perform the programmed functions. In addition, an interface for interaction with the robot is required in order to make its tasks and other data available to it. This can achieved classically through program codes, through a visual interface (the robot recognizes and learns through "lived" motion sequences) or through an auditory interface (command: "Request next workpiece!").

For many years, **robots** have been able to play off a number of **advantages over humans**. That includes, above all:

- Force
- Perseverance (no longing for quitting time or to go on holiday)
- Precision
- Speed
- Unflinching (e.g. due to fluctuations in feeling or distractions of all kinds)
- Lower hourly wage (also including all maintenance costs)—and no representation by trade unions

Now we can add an essential component to this list which will massively increase the penetration of robot use in the coming years: Artificial Intelligence.

Memory Box
Due to Artificial Intelligence, robots have a very important additional strength: **intelligence!** The resulting additional fields of application will fundamentally change the world!

We now discuss the **humanoid robots** mentioned briefly above in more detail. In the course of the development of these robots many technical challenges had to be and have to be overcome. Artificial Intelligence has made a major contribution to this. Humanoid robots should interact autonomously with their respective environment and also move independently. Either legs or a platform with wheels is used. The robots obtain their **human similarity** through artificial arms and hands and a human-like face (cf. Fig. 1.13).

Fig. 1.13 Communication with a humanoid robot named *Pepper* (Authors' own figure)

The “cuddly” shape of such a humanoid robot like *Pepper* is nowhere near the end of the development of this type of robot. Another one is called *Sophia* from *Hanson Robotics* and is a powerful example from 2016 of how similar humanoid can be shaped. She really looks like a woman and is also able to show different emotions while speaking. It shows which stage of development has already been reached here. We can no longer speak only of a “human-like” face. Until now, humanoid robots such as *Pepper* have been deliberately portrayed in a cute way in order to not frighten people and to prevent fears of substitution. That time is over now.

What is possible now? We can link the human appearance of *Sophia* with the knowledge of *IBM Watson*. In addition robots will be equipped with human-like perception (e.g. also of moods as well as gestures and facial expressions) and behavioral patterns. The result will be a **human copy with the gigantic learning and performance capacity of a computer**. By downloading from the cloud, such a robot could learn new languages every day, have the latest scientific findings and other new “tricks” at its disposal—in real-time!

How does the handling of robots already look like today—and in which direction should developments be driven forward? A study by *Capgemini* (2018) in Germany answered the exciting question how “similar” the robots should become to humans:

- 64% of respondents support human-like systems that use Artificial Intelligence.
- 52% consider Artificial Intelligence with physical human characteristics to be “creepy”.
- 71% accept it in the service area, if a human-like physiognomy is renounced.
- At the same time, 62% of respondents rated a human voice and intelligent behavior as positive.
- A positive rating of 52% is also given if the robot can detect emotions.

Memory Box

People in Germany want robots that speak like people, behave like people and are able to recognize emotions. But they must not look like real people—not yet!

In this context we speak of the **uncanny valley**. This also refers to a “creepy ditch” that describes the acceptance gap for “human” robots. If the robots become more similar to humans, the acceptance rises first. But at a certain point these robots become uncomfortable to humans. This is where the uncanny valley begins!

Despite all euphoria regarding the successes on the way to even more powerful AI-supported robots, the following little story should give us food for thought. Actually, the *Knightscope* security robot was supposed to patrol the *Georgetown Waterfront*, an elegant shopping and office complex at *Washington Harbour*. In order to maintain order here, the rolling robot could turn, beep and whistle. However, the pressure on him seemed to have become too great. To prevent the slogan “Come in and burn out”, the robot rolled independently into a well and drowned (cf. Swearingen, 2017).

A sad end, because such a security robot is actually a worthwhile business to monitor places cheaply. Normally, the security robot rolls in shopping malls and parking lots—at rental prices that are 25 cents below the federal minimum wage in the USA from 7 US-$ per hour. Incidents have been reported that such robots have been knocked down and knocked over by drunks. Besides, a little kid got run over. That does not look very secure anymore. At the same time the free death of the robot described above becomes comprehensible!

Even the **autonomously driving car** is a complex robot in its core, which accesses a multitude of functions of Artificial Intelligence. First, several cameras record the environment of the vehicle. The images obtained are evaluated and used to make decisions—all in real-time. If a red traffic light with relevance for one's own lane is detected, the car is stopped—based on further environmental information (e.g. which vehicles also brake, which follow). If a speed limit is identified as relevant for the vehicle's direction of travel, the vehicle is automatically braked down to this target speed if the car was previously driving faster. Since—as already indicated—human lives can be directly affected here, as several deaths in connection with the use of autonomous vehicles have shown, particularly high safety standards must be taken into account.

Especially the **perception of the environment** has always been a great challenge for robots. The first robot models in the 70s (such as *ELIZA*) were programmed to recognize a wall in a room. Today, however, there is much more at stake. A robot should not only be able to locate a building, but also map it. This task is called **simultaneous localization and mapping** (SLAM). It is an ability that humans already master in infancy:

- Where is the door?
- Which room do I have to go through to get into the bathroom?
- Where are which objects in the room?

A breakthrough in this area was already achieved in November 2010, when *Microsoft* launched the *Kinect* sensor device as an extension to the *xBox* gaming platform. Here it became possible to capture two players in the room and to interpret their movements even if one player was hidden by the other. In June 2011, *Microsoft* provided a software development kit (SDK) for *Kinect*. This made this application usable for SLAM research (cf. Brynjolfsson & McAfee, 2014, pp. 68–71).

Up to now, it has not yet been possible to develop a complete SLAM approach. For lawn robots, the garden still needs to be equipped with sensors that give the machine a limit so that it will not mow the flower borders. Nevertheless, self-propelled cars show the enormous progress that is constantly being made here.

An exciting domain for AI technologies are services in the **hotel sector**. The Japanese *Henn na Hotel*, opened in 2016, showed where the journey could lead. This name can be translated as "strange hotel". The entire hotel near Nagasaki is run by robots. First the guests are welcomed by *Nao*, a small robot, and informs about the hotel and its "servants". Check-in is carried out by **reception robots**, which are only partially reminiscent of people but also look like a dinosaur.

After entering the name, a camera records the face. This recording is later used as a key via a facial recognition system on the room door. The luggage is transported by a mobile robot, which also provides the "necessary" background music. The personal assistant *Chu-ri-chan* controls the light, temperature, alarm etc. in the room itself via voice control. The guests can order snacks per tablet—delivery is by drone!

Memory Box
The **use of service robots** in more and more areas of human life is already foreseeable today. Technical boundaries are often overcome more easily than cultural boundaries. While in the USA, but above all in China, Japan and South Korea, the general public is very open-minded about the innovations corresponding to them, their use in Europe and Germany often meets with great reservations and fears. These must be taken into account when developing robot-based service strategies.

Food for Thought
Perhaps we will soon be talking about a **generation R** or **generation robotic**, the **robotic natives**. The members of this generation will be as natural with robots as the kids are with smartphones and the Internet today.

Summary

- The **fields of application of Artificial Intelligence** are closely interlinked.
- An important field of application for Artificial Intelligence is the **processing of natural language**. It enables new forms of communication between human and machine.
- The ability to **process images** allows IT systems to take over new tasks. This makes it possible for machines and people to work hand in hand.
- The availability of comprehensive knowledge through **expert systems** offers the chance that—depending on the underlying data—better decisions become possible. Here, it must be checked which premises and values the decisions are based on.
- Intelligent **robots** often use several or all fields of Artificial Intelligence at the same time. They can hear and see "naturally", make well-founded decisions and carry them out independently. In sum, they will have the greatest impact on companies, economies and societies.

1.4 What Are the Global Economic Effects of Artificial Intelligence?

A study by McKinsey (2018a) shows the **global economic AI effects** that will accompany the use of Artificial Intelligence. Initially, it is forecasted here that by 2030 about 70% of all companies will introduce at least one type of AI technology. Less than half of all large enterprises will use the full range of AI technologies.

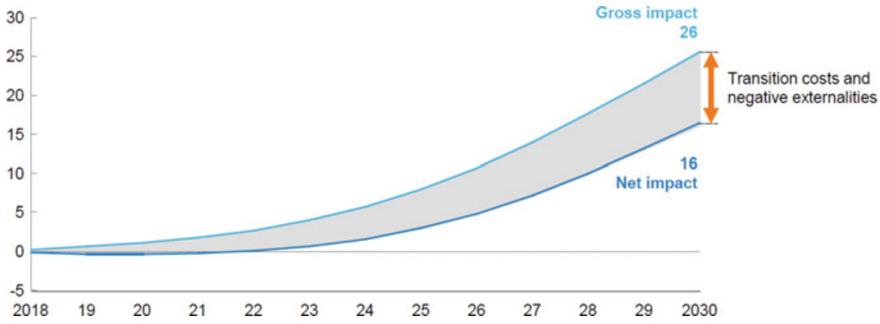

Fig. 1.14 Cumulative development of the economic effects of Artificial Intelligence—comparison to today. *Source* McKinsey (2018a, p. 23)

Memory Box
If competition effects and transition costs are excluded, **Artificial Intelligence** could deliver an **additional economic output** of around US-$13 trillion by 2030. This would increase the global gross national product by about 1.2% per year (cf. McKinsey, 2018a, p. 2f.).

Even if this prognosis is too high. We should all understand it as a challenge to deal intensively with the possibilities of Artificial Intelligence—rather earlier than later!

It is important to note that the **economic impact of the use of AI** is initially slow to emerge and will only pick up speed in the coming years. Thus, the expected use of Artificial Intelligence by companies is shown by the curve progression documented in Fig. 1.14: First of all, there will be a **cautious start**, due to the necessary investments associated with learning and the use of technology (cf. Chap. 10). Then an **acceleration** will begin, driven by the increasing competition and the increase of the own AI-related competences in the companies. Consequently, the **growth contribution of Artificial Intelligence** around 2030 could be three or more times higher than in the next five years. The relatively high initial investments in personnel and systems, the continuous further development of technologies and applications, and the considerable transition costs associated with the use of AI systems could limit acceptance by small enterprises and at the same time reduce the net effect of the overall AI use (cf. McKinsey, 2018a, p. 3).

A global challenge is that the introduction of Artificial Intelligence could increase the existing differences between countries, companies and workers. First of all, the performance differences between the countries will increase themselves. Those—mostly developed—**economies** that establish themselves as AI leaders could achieve an additional 20–25% economic advantage compared to today. On the other hand, emerging economies can only exploit about 5–15% of these benefits. The background to this is that both country groups (AI leaders here, emerging countries there) need different strategies in order to achieve acceptance of Artificial Intelligence in society and the economy (cf. McKinsey, 2018a, p. 3).

Many **industrialized countries** will inevitably have to rely on Artificial Intelligence to achieve higher productivity growth. Finally, the pace of growth is slowing in many of these countries. This is not least due to the ageing of the population and the highly saturated markets. In addition, wages are relatively high in the industrialized countries, which reinforces the need to replace labor by machines. **Developing countries** generally have other ways of improving their productivity. This includes the adoption of best practices in industrial actions—as well as the restructuring of their industries. This is why important incentives for greater use of AI are lacking here. However, this does not necessarily mean that developing countries are destined to lose the AI race (cf. McKinsey, 2018a, p. 3f.).

Let us take a look at individual regions. Some developing countries—above all China—are pushing the use of AIs in a strictly sustainable manner. The analysis of the Chinese situation should take into account the following points. Belonging to the group of developing countries is based on gross domestic product per capita; China is still a developing country after that. At the same time, however, China is also the second largest economy in the world after the USA and before Japan! In addition, today China has the **most valuable AI startup in the world**. The company *Sensetime* already has a market capitalization of US-$ 2.8 billion (cf. Ankenbrand, 2018; Sensetime, 2018). In presentations by Chinese companies it is noticeable that they often place Artificial Intelligence at the center of the 4th industrial revolution—in addition to the emergence of cyber-physical systems (cf. Kreutzer, 2018; Kreutzer & Land, 2016, p. 3). It is no coincidence that the CEO of the Chinese company *Cheetah Mobile*, *Sheng Fu*, formulated the mission for his company as follows (Cheetah Mobile, 2018):

> Artificial Intelligence is re-shaping the whole industry, as well as our entire way of thinking. Therefore, we are going to use AI to achieve Cheetah's new mission for the next 10 years – Make the World Smarter.

Therefore, China has defined **Artificial Intelligence as a target industry** at the national level in the master plan "Made in China 2025". By 2030, China wants to be more than just a global **innovation center for Artificial Intelligence**. The Chinese AI industry will then have a value of approximately US-$150 billion—and the AI-supported industry ten times that amount. To help achieve this goal, *Sensetime* has developed its own deep learning platform called *Parrots*. This can be characterized by the following attributes (cf. Sensetime, 2018, pp. 9, 17–20; further Lee, 2018):

- **Super deep network** (1207 network layers)
- **Mega data learning** (including simultaneous training with two billion facial images; more than ten billion images and videos from 18 industries are available)
- **Complex network training** (support of multimodal learning)

A study by *Elsevier* (2018, p. 9) shows that China already leads the **ranking of publications on Artificial Intelligence** from 2013 to 2018—clearly ahead of the USA and all other countries. By the way, India is in 3rd place here—far ahead of Great Britain, Japan and Germany.

Europe has just (with a sighted eye) refrained from assuming a (leading) role in Artificial Intelligence in the future and thereby achieving strategic competitive advantages. The European General Data Protection Regulation (GDPR), which came into force in 2018, makes it increasingly difficult for European companies to access relevant data for the development of Artificial Intelligence. There is a simple equation:

No comprehensive databases = no high-performance AI systems

Unlike China, Europe has tried to protect the privacy of individuals in the digital world. However, it is questionable whether the new GDPR is really capable to achieve this. The legal framework developed into a bureaucratic monster that stifles creativity and devours budgets that could have been used for more value-adding digital transformation and AI use.

Memory Box

Against this background, it becomes understandable why only US and Chinese companies dominate the **development of AI applications** today. These are the so-called GAFA companies (*Google/Alphabet*, *Apple*, *Facebook* and *Amazon*), plus *IBM* and *Microsoft*. This is why more precisely they are the **GAFAMI companies**. *Facebook* even develops AI computer chips itself. The Chinese counterparts *Baidu*, *Ali-baba* and *Tencent* are grouped together under the term **BAT companies**.

Food for Thought

The ***Facebook Cambridge Analytica* debate** at the latest confirmed what we had known for a long time: our data are systematically abused. Unfortunately, the current GDPR does not succeed in preventing such abuses. On the contrary, even small craft businesses, medium-sized enterprises and startups now have to master comprehensive bureaucratic challenges in order not to be attacked by the warning notice industry. This can quickly lead such companies to the edge of existence, as reports in the daily press regularly show. Is this actually the desired progress for our society? Certainly not!

On the one hand, it is worth acknowledging that Europe wants to protect the rights of individuals. However, in its current form, the GDPR overshoots the mark. European companies are endeavoring to take into account the new requirements defined there. Largely unaffected by this, the mega players *Amazon*, *Facebook*, *Google* & Co. simply obtain a permission for further data use. People usually give these—already annoyed—unwillingly, without having read the new regulations (often dozens of pages). After all, we want to continue our *Google* search—and we do not want to be distracted. Thus, the data octopuses will continue to grow—and less dominant companies will continue to lose data and thus power, influence and competitiveness.

Does Europe want to become publicly glassy people like in China? Certainly not! Which economic options exist for companies in Europe to develop their own AI solutions? If Europe cannot find a responsible way to handle the data which is

the foundation of every AI technology, they will have to accept the fact that Chinese companies will dominate with their solutions in the foreseeable future. The Chinese companies *Alibaba*, *Baidu* and *Tencent* are pushing ahead with their AI solutions. Perhaps these are even more powerful because it was possible to exploit comprehensive databases during the development process. If these solutions convince the users, we will have new—in this case—Chinese mega players on the world market!

It is therefore important to achieve a balance in Europe between privacy and entrepreneurial interests and to fundamentally rethink the GDPR.

The member states of the **European Union** (EU) have now announced their intention to step up cross-border AI activities. This is intended to ensure that Europe remains or becomes competitive in these technologies. At the same time, the social, economic, ethical and legal effects of Artificial Intelligence are to be mastered together. The EU demands that US-$24 billion should be invested in AI research by 2020. A number of European countries have also promoted national initiatives in education and research in order to promote their own AI activities (cf. McKinsey, 2018a, p. 7). It remains to be seen what fruits this approach will yield.

Where does the USA stand when it comes to Artificial Intelligence? The companies *Alphabet*, *Amazon*, *Apple*, *Facebook*, *IBM* and *Microsoft* are particularly active in this area and are trying to integrate the knowledge they have gained into existing and future products and services and to develop new business models. Since Europe has so far not emerged much in the competition for the leading role in AI development, the use of Artificial Intelligence is likely to remain a US-American-Chinese duopoly. Perhaps China will even win this competition because—as shown above—enormous amounts of data are available there for training the systems. How did the AI mastermind *Fred Jelinek* put it so beautifully?

"There is no data like more data."

It is true that the **data gap** between the USA and China is huge. It cannot be explained solely by the different size of the population. The number of data points available per inhabitant in China is simply many times higher—and their number continues to rise steadily (cf. Armbruster, 2017).

Memory Box

The fields of application of Artificial Intelligence do not ask on what basis these systems were developed! For success on the world market it is (unfortunately) only a question of who owns the more powerful systems. Europe currently has a bad hand to play here whereby the USA and China take over the leading role.

Which role is **Russia** going to play in the AI challenge? Through a strong Artificial Intelligence, a maximum autonomy is to be reached, which goes far beyond a bare imitation of human intelligence. It seems to be less about the question whether this stage will ever be reached, but only about the "when". Russia entered the AI age in 2012 which ambitious goals (cf. 2045 Strategic Social Initiative, 2012):

- Between 2015 and 2020 they planned to develop an **Avatar A** as a robotic copy of the human body remotely controlled via brain computer interface.
- For the period 2020–2025 Russia intended to develop an **Avatar B** in which a human brain is transplanted at the end of one's life.
- Between 2030 and 2035 an **Avatar C** with an artificial brain should be developed, in which a human personality is transferred at the end of one's life.
- In the timespan 2040–2045 a hologram-like **Avatar D** should exist. These were the targets.

So far Russia has owed it to us to present convincing solutions in the field of Artificial Intelligence.

McKinsey (2018a) provides an in-depth **analysis of the relative competitive position of different countries**. While the USA and China are leading the race, Germany is in the lower midfield. Countries such as Singapore, the UK, the Netherlands and Sweden are much better positioned in this respect. An exciting phenomenon is that the gaps in AI use between countries tend to widen over the years (cf. McKinsey, 2018a, p. 35). As already mentioned, the introduction and adoption of AI technologies can provide a major boost in the slowly growing industrial countries. Figure 1.15 shows that the additional **AI-supported growth** in some developed countries (such as Sweden, South Korea, the UK and the USA) alone could become as large as the growth forecasts made today.

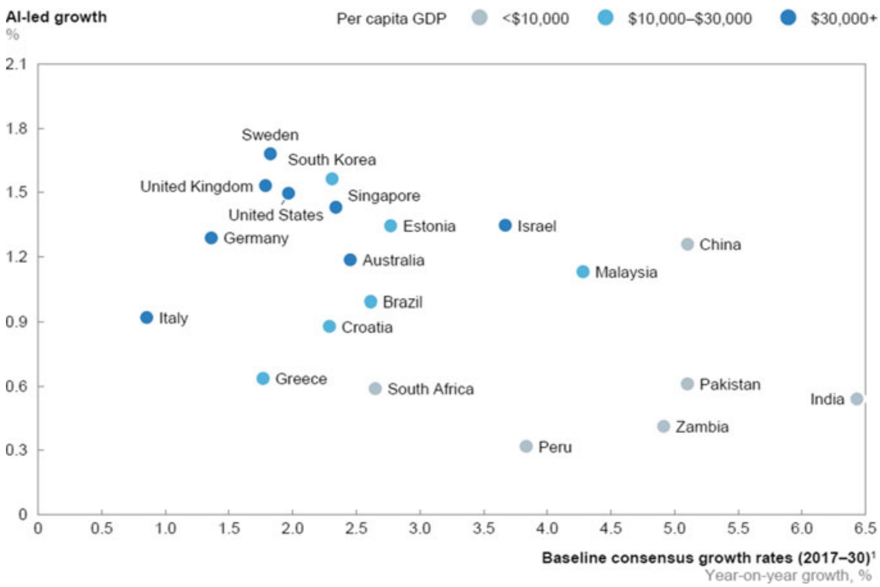

Fig. 1.15 Additional contribution of Artificial Intelligence to growth at country level. *Source* McKinsey (2018a, p. 36)

AI technologies could lead to a **performance gap on a company level** between top performers on the one hand and slow-users and non-users on the other (cf. McKinsey, 2018a, p. 4). Among the **AI leaders** are companies that will fully integrate AI tools into their value chains over the next five to seven years. They will benefit disproportionately from the use of AI. They could potentially double their cash flow by 2030. This would mean additional annual **net-to-cash flow growth** of around 6% for more than the next decade. The AI leaders usually have a strong digital base, a higher propensity to invest and exciting business cases for the use of Artificial Intelligence. The AI leaders are faced with a large number of **AI laggards** who will not use AI technologies at all or will not have adopted them completely by 2030. This group may face a 20% **decline in cash flow** from today's level. It is assumed that the same cost structure and comparable business opportunities will be used.

Such a divergent development can also occur at the employee level. The **demand for jobs** could shift from jobs with repetitive activities to socially and cognitively demanding tasks. Job profiles that are characterized by repetitive activities and/or require only low digital skills may experience the greatest decline in the proportion of total employment: The share of these tasks could fall from around 40% to almost 30% by 2030. On the other hand, demand will increase for workers for non-recurring tasks and activities requiring high digital skills. Their share could increase from around 40% to more than 50% during this period. This could strengthen the war for talent with regard to people who have the abilities to develop and use systems of Artificial Intelligence (cf. McKinsey, 2018a, p. 4).

However, the **forecasts on the employment effects** of the use of AI are not uniform. *OECD* studies assume that there could be a **polarization of the labor market**. In addition to the demand for highly qualified people described above, there could also be an increasing demand for low-skilled people. As the saying goes: "After all, somebody has to clean the apartment of the digital staff in the same way, serve the food and fill the coffee to go into the cup" (cf. Bollmann, 2018, p. 136). As a result, primarily jobs with a medium qualification profile would be lost. Such a development has already been observed in Germany in the last two decades (cf. Bollmann, 2018, p. 135).

Food for Thought

The effects which will occur in the individual case depend on the speed and extent of AI use in the individual companies and in the economy as a whole. If Artificial Intelligence is primarily used to **increase efficiency**, a large value creation potential of the new technology remains untapped. If, on the other hand, companies increasingly use Artificial Intelligence for **product and service innovations** or for the **development of new business models**, much more comprehensive effects on economic results will be achieved.

McKinsey (2018a, pp. 13–19) additionally investigated various fields of Artificial Intelligence. The results of a simulation are presented below. First of all, AI-driven productivity growth, including work automation and innovation, and the

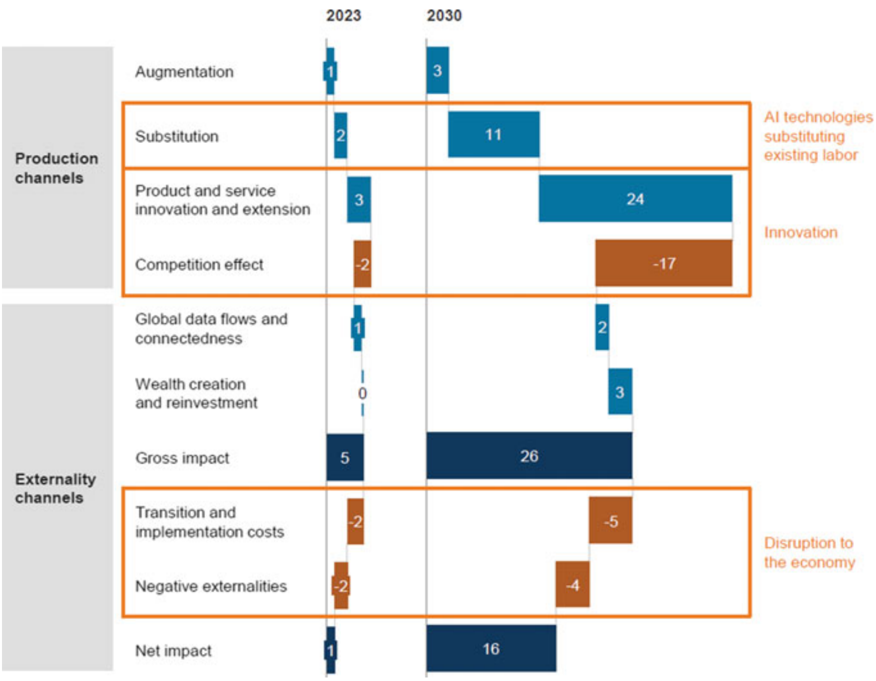

Fig. 1.16 Analysis of the net economic impact of Artificial Intelligence—breakdown of the economic impact on gross domestic product (cumulative increase compared to today in %). *Source* McKinsey (2018a, p. 19)

emergence of new competitors are influenced by several factors. A distinction is made here between micro factors and macro factors. The first three fields of action investigated relate to **micro factors**. They analyse the effects of the introduction of AI on the production factors of the companies. This is about the speed and extent of AI introduction in the companies. The **macro factors** refer to the general economic environment and the increasing use of Artificial Intelligence in an economy in general. This also concerns the global integration and labor market structure of an individual country (cf. Fig. 1.16).

In the following, the micro factors are discussed first.

- **Field of activity 1**: **Augmentation**
  McKinsey surveys from 2016–2017 show that companies have invested only 10–20% of their "digital" budgets in AI applications so far; however, this share may increase in the future as AI applications advance. These AI investments have an impact on many other areas, such as the employment situation. At this point, the term "**augmentation**" refers to the enrichment of labor and capital by Artificial Intelligence. The increasing AI usage requires the **creation of jobs** to set up an AI infrastructure and monitor its operation, e.g. by engineers and big data analysts.

Other new jobs focus on the test the of AI results "through human eyes". *Google* alone employs 10,000 "evaluators" who watch *YouTube* videos in order to re-examine critical content identified by Artificial Intelligence. *Facebook* will also significantly increase the number of "moderators" required to check content in order to implement new legal requirements. Thus, the use of AI leads to new job profiles.

The need to create AI-driven new jobs also results from the phenomenon that AI applications are generally difficult to generalize. An algorithm that can easily distinguish people from animals in photos will fail to detect cars and trucks. On the way to a **generic Artificial Intelligence** (also called **Artificial General Intelligence**) there are still many tasks to be performed by humans. As Fig. 1.16 shows, the overall economic effects of augmentation are at a low level. A cumulative increase in gross domestic product of only 1% by 2023 and of only 3% by 2030 is expected.

- **Field of activity 2**: **Substitution**

  Technologies that lead to better results and/or higher cost efficiency tend to replace other production factors. This is accompanied by the **substitution of work**, especially by automation of repetitive tasks. By 2030, the automation of activities could replace on average around 15–18% of working hours worldwide. The extent to which this will happen will depend on the relative costs of the (AI) resources required in each case. It is already predictable today that in many professions certain activities will be automated and/or substituted by Artificial Intelligence. This applies to call centers, where many tasks can be performed by chatbots. In many other fields such substitution effects are also apparent (cf. Sect. 4.1.2).

  Automation of labor could contribute about 2% to global GDP by 2023 and about 11% or about US-$9 trillion by 2030 (cf. Fig. 1.16). This process is achieved through productivity gains and requires that the released labor can be used elsewhere in the economy. At aggregated level, the increase in productivity can lead to higher economic performance, creating additional jobs elsewhere. This can benefit the economy as a whole, while employees can suffer from AI-induced change processes. Overall, the "substitution" described here is one of the particularly effective effects of Artificial Intelligence.

- **Field of activity 3**: **Product and service innovations and extensions (including competition effects)**

  Another important field of investigation are **AI-driven or AI-supported innovations**. While **process innovations** can increase a company's productivity (cf. fields of activity 1 and 2), **product and service innovations** make it possible to open up new fields of action. *McKinsey* surveys show that about a third of companies have invested in Artificial Intelligence to achieve such innovations.

  With regard to the macroeconomic effects, it should be taken into account that innovations also replace existing products and services. Therefore, not all the value that companies will achieve through innovation is "new" to the economy. An example of this is *Uber*, which has not only won new customers for the transport of passengers but has also replaced classic taxi rides. Platforms such as

Amazon and *Airbnb* have not only generated new business but have also substituted traditional retail and hotel sales. Thus, a large part of the innovation potential of Artificial Intelligence will lead to a **shift in production between companies** (cf. Kreutzer & Land, 2015 and 2016).

Figure 1.16 shows that product and service innovations and additions will have a cumulative effect on GDP of 24% by 2030. On the contrary, there are **negative competition effects** of 17% cumulated over the same period. The sales increases on the one hand lead to shifts in market shares and to displacement effects on the other hand. This can endanger companies that do not overwork their product and service portfolios. In order to improve cash flow in times of increasing competitive pressure, some companies are likely to reduce their investment in research and development and in the use of new technologies. This can lead to a vicious circle, as this behavior may increase the gap to AI-using companies.

Overall, according to *McKinsey's* simulation, innovations in products and services can account for up to about 7% or US-$6 trillion of potential GDP by 2030 (net effect). An important reason for these significant AI effects is the fact that companies that rely on Artificial Intelligence can quickly increase sales by reaching underserved markets with existing products and services more effectively. In addition, gains can be achieved through productivity increases resulting from the substitution of human labor. Another reason is that most technologies encourage innovation in products and services and help to create and develop new markets.

Macro factors include the question of how the use of AI affects cross-border trade. In addition to overall economic profits, there are also transitional costs for the increasing use of AI.

- **Field of activity 4**: **Global data flows and connectedness**

  Already today, the **cross-border exchange of information**, **goods and services** contributes significantly to the overall economic performance. Countries that belong to the globally connected and digitally developed economies will receive further growth impulses from Artificial Intelligence. *McKinsey* assumes in their simulation that Artificial Intelligence could account for up to 20% of digital flows.

  Artificial Intelligence can contribute to digital flows in two ways. The first is to enable more efficient cross-border trade. *McKinsey* estimates that about one third of **digital data flows** are related to cross-border e-commerce. Artificial Intelligence can promote global trade by improving supply chain efficiency and reducing the complexity of global contracts, classifications and trade conformity. Friction losses in the supply chain can be reduced by using natural language processing to automatically identify traded goods and correctly classify them according to customs taxonomies. **Improving the transparency and efficiency of the supply chain** can help companies to ensure better trade finance and reduce banks' concerns about compliance. Banks, in turn, can use AI technologies to process trade documents, which facilitates risk analysis.

  The second way in which Artificial Intelligence can contribute to the full utilization of global flows is through improved and enhanced **use of cross-border**

data flows—independent of e-commerce activities. There is still a great potential for optimization here, especially in the area of services. Every day, large amounts of data exceed the limits and an increasing proportion of these data streams can drive AI applications. Large amounts of data from doctors' practices and hospitals around the world could improve the accuracy of diagnosing rare cancers (cf. Sect. 6.1). The quality of AI translation engines can also be significantly improved if they are trained with qualified data in different languages. The performance of chatbots, message aggregation engines and recommendation sites can also benefit from global data flows.
In addition, Artificial Intelligence can lead to **knowledge spillover effects**. In this way, digital talent platforms accessible in all countries can help companies to meet their needs for expertise with specialists from all over the world. At an early stage, such digital know how exchange and comparison still takes place manually. Artificial Intelligence can sustainably improve the quality of this matching and, above all, accelerate it. Examples are *proSapient* and *NewtonX*. ProSapient (2019) refers to itself as "A Next Generation Expert Network" to ensure a connection to experts around the world. NewtonX (2019) sees itself as the world's most advanced knowledge access platform. This platform works across industries, topics and geography and enables easy access to the best experts in the world.
Overall, *McKinsey's* simulation shows that the cumulative effects of these developments remain within narrow limits at 1 and 2% respectively (cf. Fig. 1.16).

- **Field of activity 5**: **Wealth creation and reinvestment**
  Since Artificial Intelligence contributes to the higher productivity of economies, the results of efficiency gains and innovations can be passed on to workers in the form of wages. Such **AI-induced wealth creation** could generate spillover effects that boost economic growth. When workers' incomes rise and they spend more and companies reinvest their profits in the company, economic growth is promoted—an upward spiral. This can create additional jobs, grow the AI value chain and strengthen the IT sector, which can make an important overall economic contribution through **reinvestment**.
  McKinsey's simulation also shows here that such effects cannot be expected in the short term. By 2030, the cumulative effects of these developments will also be limited to 3% (cf. Fig. 1.16).

The **cumulative overall effect** ("gross impact") of the five fields of activity discussed so far in Fig. 1.16 shows a moderate value of 5% by 2023. In contrast, a cumulative overall effect of 26% is expected by 2030. This makes it clear that the AI effects on the gross domestic product will remain quite manageable in the near future; the main effects will only become apparent in the years after 2023 (cf. Fig. 1.14).

Of course, such a simulation must also take a look at the **costs and other negative effects of AI use**. The corresponding drivers and effects are described below.

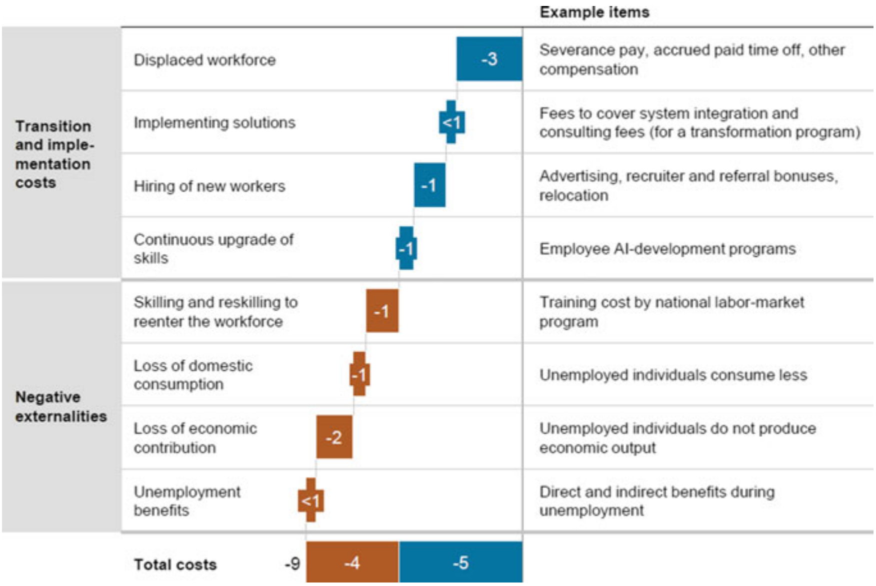

Fig. 1.17 Costs and negative effects of the transition to an AI-based economy—simulation of the percentage impact by 2030. *Source* McKinsey (2018a, p. 22)

- **Field of activity 6**: **Transition and implementation costs**
  With the increasing use of AI, additional costs are incurred. In particular, the release of employees has a negative impact. The costs for the implementation of corresponding systems, the expenses for the recruitment of new employees and for further qualification of the workforce must also be taken into account (cf. Fig. 1.17). Of course, these costs also have an impact on the economies as a whole. Negative cumulative effects on gross domestic product of 2% are expected by 2023 and 5% by 2030 (cf. Fig. 1.16).
- **Field of action 7**: **Negative externalities**
  AI use can also lead to **negative external distribution effects** (cf. Fig. 1.17). Above all, these can have an impact on the employees. The increased use of AI can lead to a decline in the labor force share in economies. The use of AI technologies could increase pressure on employment and wages, thereby reducing the labor force's share of income and potential economic growth. This can lead to a (temporary) loss of consumption by the persons concerned (e.g. in times of unemployment or during necessary retraining phases). In these phases, the countries concerned may also face higher expenses.
  McKinsey research shows that, in theory, up to 14% of employees may have to change their job roles—partly not only within companies, but also between companies, sectors and/or regions. In addition, it turns out that most employees will compete with AI systems for selected tasks. Less than 10% of occupations consist of activities that can be fully or more than 90% automated by AI.

Nevertheless, in about 60% of the work areas at least one third of the activities can be automated. This goes hand in hand with considerable changes for employees and jobs.

The associated costs of **losing domestic consumption** due to unemployment of about US-$7 trillion by 2030 could reduce the positive effect of Artificial Intelligence by four percentage points by 2030. Transition and implementation costs could account for a further five percentage points of costs. Figure 1.17 shows in detail how these negative effects are presented.

Consequently, the **economic use of AI-based automation and innovation** has its price. The use of AI is likely to shock labor markets and lead to significant costs. It is very difficult to calculate costs accurately as they are likely to occur on several fronts on the supply and demand sides and in many cases will be linked. In addition, transition costs in one part of the value chain can generate a new value in another part.

If the positive and negative effects of AI use are taken into account simultaneously, the cumulative net effect on global gross domestic product is plus 1% by 2023 and plus 16% by 2030 (cf. Fig. 1.16).

Memory Box

The use of Artificial Intelligence will have a lasting and penetrating effect on employees, companies and economies. As with many new technologies, these effects will initially be limited over the next five years. The comprehensive effects will only become apparent after 2023!

How will the various effects cumulatively affect **the labor market until 2030?** First of all, it can be said that about half of all work activities could be automated through the use of AI technologies. However, a number of technical, economic and social factors stand in the way of this automation potential by 2030. In fact, McKinsey (2018a, p. 44f.) expects an average automation rate of 15% for a scenario of 46 countries. This share will vary greatly from country to country. Figure 1.18 shows that overall employment demand will at best stagnate compared to today. In each individual country, **employment dynamics** will depend on the interplay of the factors discussed so far. The advance of Artificial Intelligence will lead to both—job losses and the creation of new jobs. *McKinsey's* simulation led to a **net effect on total employment** of only −1%. Still, this could hide serious distortions in individual companies and countries.

Food for Thought

News—online and offline—regularly communicate the AI-driven dismissal of thousands of employees. In 2018, the statement of the German fashion e-commerce giant *Zalando* that they would focus more on algorithms and Artificial Intelligence in marketing in the future. This was the reason why up to 250 advertising experts had to leave while at the same time AI developers were being searched. This marked the beginning of *Zalando's* biggest restructuring in his still young company history (cf. Jansen, 2018). The motto here was striking: algorithms and Artificial Intelligence instead of human beings.

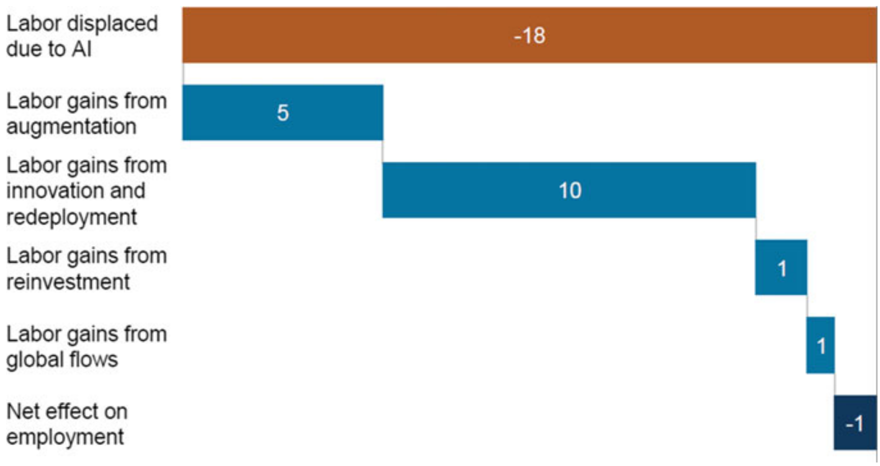

Fig. 1.18 Cumulative effects of AI use on employment up to 2030—in % (full-time equivalent basis). *Source* McKinsey (2018a, p. 45)

This decision had an enormous media echo and intensified the fears among the population, to which disastrous effects Artificial Intelligence can lead. That is just one side of the coin. We—as teachers, university lecturers, entrepreneurs and politicians—should also communicate the positive effects of Artificial Intelligence. Only then it can be achieved that the global use of AI does not come to a standstill because of sheer fear.

Summary

- The **use of Artificial Intelligence** will have a massive impact on employees, companies and economies as a whole.
- **Employees** will lose their jobs while new jobs are created. All in all, the responsibility of each individual to continuously qualify for future requirements is growing.
- **Companies** are faced with the challenge of recognizing and exploiting the opportunities offered by Artificial Intelligence. At the same time, the risks must be identified and managed as well.
- The position of global **economies** will change depending on the use of Artificial Intelligence. Existing imbalances can be increased or decreased equally.
- It is expected that the **total number of workplaces** worldwide will not change significantly until 2030 as a result of the use of Artificial Intelligence. Nevertheless, there may be significant distortions in the individual companies and economies.
- Overall, the effects of the use of AI on companies and society will remain limited until 2023. Only from 2023 onwards Artificial Intelligence will develop its **disruptive potential** comprehensively and lead to significant product, service and process innovations.

- Each national economy for itself and each group of countries is requested to recognize and use the **potential for change in Artificial Intelligence** for its own area of responsibility at an early stage. Waiting is not an acceptable strategy here!

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2 Basics and Drivers of Artificial Intelligence

Abstract

In this chapter we discuss the basics and drivers of Artificial Intelligence. The key drivers are Moore's Law, digitalization and dematerialization of products, services and processes, the connection of these within global network, big data and new technologies. We also analyse the investments in Artificial Intelligence.

There are not only individual factors responsible for the fact, that Artificial Intelligence has gained so much importance in recent years. It is rather the interaction of different developments that reinforce each other. The following **drivers of Artificial Intelligence** deserve special mention (cf. Brynjolfsson & McAfee, 2014, p. 277f; Kreutzer & Land, 2015, 2016):

- **Exponential development of the performance** of IT systems and technologies based on them
- The **advance of digitalization and dematerialization** into more and more areas of value creation
- **Increasing connectivity between objects, processes and human beings**, which not only leads to the development of the Internet of Things (IoT), but also to an Internet of Everything (IoE).

Especially the "mixture of exponential, digital and combinatorial innovation" offers many opportunities and risks for companies (Brynjolfsson & McAfee, 2014, p. 277).

Memory Box

These developments lead to the fact that the future changes will never take place as slowly as before! Let us enjoy the "slowness of the change experienced so far"! It will not stay that comfortable, because the speed of change will increase in an incredible manner now!

R. T. Kreutzer and M. Sirrenberg, *Understanding Artificial Intelligence*, Management for Professionals, https://doi.org/10.1007/978-3-030-25271-7_2

2.1 Moore's Law and the Effects of Exponentiality

The combination of the above-mentioned **drivers of Artificial Intelligence** leads to a **tipping point** in the sense of an important trend reversal towards an exponential development in the AI systems. In order to understand what **exponential growth** means, the following thinking task helps:

- How many meters does a person cover when he or she takes **31 analogue steps** of one meter in length? About 31 m.
- How many meters does a person cover when he or she takes **31 exponential steps** and the step size doubles from step to step? When we take the 31st exponential step, we have covered more than a billion meters!

This exponentiality is the basis of **Moore's Law**. Based on empirical observations, *Gordon Moore* derived the "law" already in 1965 that a **doubling of the performance of integrated circuits** can be achieved approximately every two years. If we date the construction of the first integrated circuit back to the year 1958, we now have more than 32 doubling cycles behind us. This means that these doublings are now taking place at an already very high level of performance.

An end to this development is not yet in sight, even though the development dynamics of integrated circuits have declined a bit in recent years—since the mechanics of miniaturization have reached their physical limits. Nevertheless, the next leaps in technology and performance will put everything that has been achieved so far in the shade again. Now, the next gigantic boost is expected from **quantum computing**, which overcomes the dichotomy of "0" and "1".

Food for Thought
If the automotive industry had achieved the same technological breakthroughs as the computer industry, the 1971 Volkswagen Beetle would today reach a speed of 480,000 km per hour—at a purchase price for the vehicle of US-$0.045 (cf. Hohensee, 2015). These are the consequences of the exponential developmental boosts described!

2.2 Digitalization and Dematerialization of Products, Services and Processes

Parallel to the exponential developments, **digitalization** and thus **dematerialization of products, services and processes** are taking place in many areas. The overcoming of the physicality of products, services and processes associated with dematerialization often creates the prerequisites for making these areas accessible to Artificial Intelligence, because physical boundaries and restrictions become redundant (cf. Kreutzer & Land, 2015).

Figure 2.1 visualizes the extent of dematerialization. It shows which applications have already been transferred in digital form to smartphones or other mobile devices and developed them into smart service terminals. **Independent products** such as telephones, cameras, clocks, alarm clocks and dictation machines have become basic functions of the smartphone and are firmly integrated into it. The make-up mirror has been replaced by the selfie function. Many other products were turned into an app: The range includes the spirit level, the flashlight and the compass. In addition, blood pressure can be monitored, online games can be played and e-mails, notes and more can be dictated via *Siri* and Co. Therefore, their analog counterparts are omitted. At the same time, navigation systems, scheduling and mobile payment systems are digitally available via various apps. Entire **administration process chains** are also transferred to the smartphone.

In addition, Fig. 2.1 shows that **access control** is also becoming increasingly dematerialized. It ranges from keyless drive for cars to online check-in in hotels, on flights and in the cinema. Also the access to the smart home can be controlled via an app. At the same time, the smartphone also covers—as a matter of course—the important **receiving channels** TV, radio, telephone and Internet. This enables access to "all" human resources via a portable device.

Figure 2.1 also shows that the smartphone is developing into a central **content platform**. In digital form, books, newspapers, magazines as well as CDs and DVDs or their contents are physically available on the smartphone. Alternatively, the desired content (such as music and videos) can be streamed when the user requests it. Classic cartographic works (such as city maps or street maps) are dematerialized, as the necessary content for navigation is available online. Even flight plans in book form (e.g. from *Lufthansa*), which every manager was equipped with years ago, are

Fig. 2.1 Dematerialization of products, services and processes—the development of the smart service terminal (Authors' own figure)

no longer printed. Here, the contents have been dematerialized, too. The provision of coupons is increasingly shifting to the online world. Pictures moved from a photo album to the mobile device, too: When was the last time you showed someone a photo album—and did not present your photos on a smartphone or tablet? If you actually still use a photo album, this leads to surprise effects—usually positive ones.

With the dematerialization of products and services, the underlying **processes** can be digitalized, too. Here, we should think of consulting processes through chatbots. Payment processes are also increasingly being dematerialized (not least through the introduction of *Alipay*, *Apple Pay*, *Google Pay*, *WeChatPay* etc.). The biggest shift of processes into the digital world has taken place in online shopping.

The next stage of digitalization is already arising: **smart fabrics**. These are intelligent clothes or textiles. Materials containing digital components (e.g. small computers) can be used for communication.

2.3 Connecting Products, Services, Processes, Animals and People

The developments described are reinforced by a trend towards **connecting** "**things**". Figure 2.2 shows the relevant dimensions. Since connectivity takes place via the Internet, we speak of the **Internet of Things** (IoT).

However, the dynamics of connectivity today are not limited to "things". Not only products, but also services, processes, animals and people are connected with each other. Therefore we use the term Internet of Everything (IoE). Figure 2.3 shows the relevant fields we have to think of. The Internet of Things is a subset of the Internet of Everything. In the private environment things like clocks, refrigerators, cars, houses, hutters, dolls etc. are connected to the Internet. In addition, more

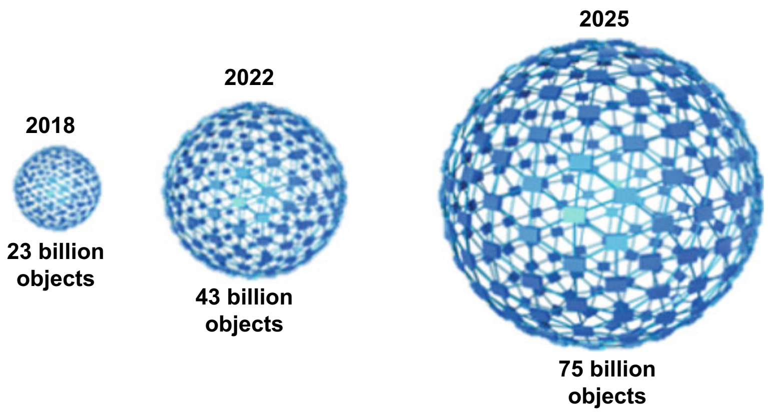

Fig. 2.2 How will the "connection intensity" evolve? (Authors' own figure based on Statista 2018)

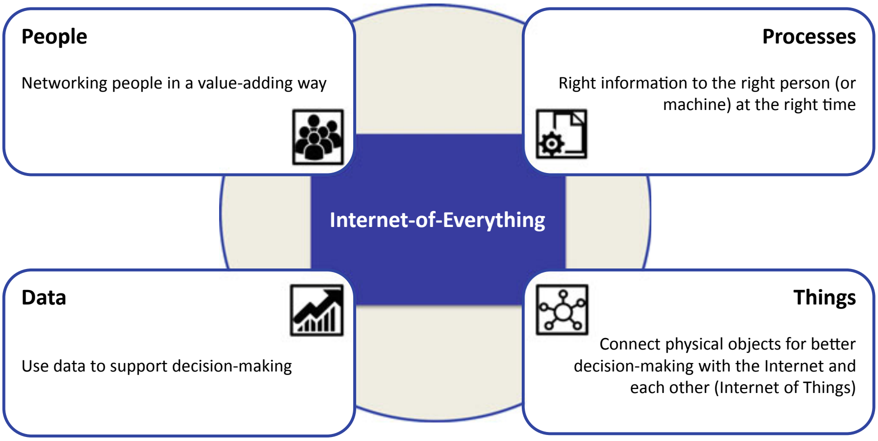

Fig. 2.3 Design of the Internet of Everything (Authors' own figure)

and more processes are being interconnected. In the business environment this can support the connection between the field staff and the back office as well as between different production locations across country and time boundaries.

In addition, **data** from different sources can be analysed together. This is a particularly exciting field of application of Artificial Intelligence (cf. Fig. 2.3). In addition, the connected use of sensors is generating more and more data that is relevant for AI processes. Since the costs for sensors are continuously falling, a **sensor economy** will emerge that comprehensively intervenes in the everyday reality of all people. The already described user interfaces via voice and image also support the generation of further data, which further expand the Internet of Everything and form the basis for expert systems and the use of robots.

Finally, more and more **people** can be connected directly to the Internet (cf. Fig. 2.3). This can be achieved via fitness trackers or—in the case of cyborgs—directly via implanted chips. **Cyborg** refers to people who have permanently supplemented their bodies with artificial components (here chips). The term cyborg is derived from **cyb**ernetic **org**anism. The chipping of people is called **body hacking**.

The intensity of the connectedness will be further increased by the **penetration of the LPWAN** (Low Power Wide Area Network). The LPWAN is currently the fastest growing IoT technology. It connects battery-powered devices with low bandwidth and low bit rates even over long distances (up to 30–35 km). This technology will enable further AI applications.

The impact of **Internet of Everything** quantifies a prognosis from Cisco (2015). By 2022, the Internet of Everything is expected to generate worldwide **profits and savings** of the following order of magnitude:

- US-$2.5 trillion through better **asset utilization**
- US-$2.5 trillion from increased **employee productivity**

- US-$2.7 trillion through **supply chain improvements**
- US-$3.7 trillion from enhanced **customer experiences**
- US-$3.0 trillion through **innovations**

In total, the Internet of Everything is expected to generate **profits and savings** of US-$14.4 trillion. An increase in corporate profits of up to 21% is predicted (cf. Cisco, 2015). We do not have to follow these figures in every single detail—just looking at the foreseeable potential should call for action!

Memory Box
The effects associated with the development of the Internet of Everything will have a dramatic impact on individual companies, entire industries and each individual country. Therefore, these developments should not only be observed, but also actively shaped!

2.4 Big Data

As already mentioned, the **data basis** is of particular importance for the training of AI algorithms. Here, it is essential that companies have access to **big data**—i.e. a large, qualified treasure trove of data. Big data can be defined by the following criteria (cf. Fig. 2.4; Fasel & Meier, 2016, p. 6; Kreutzer & Land, 2016, p. 125f):

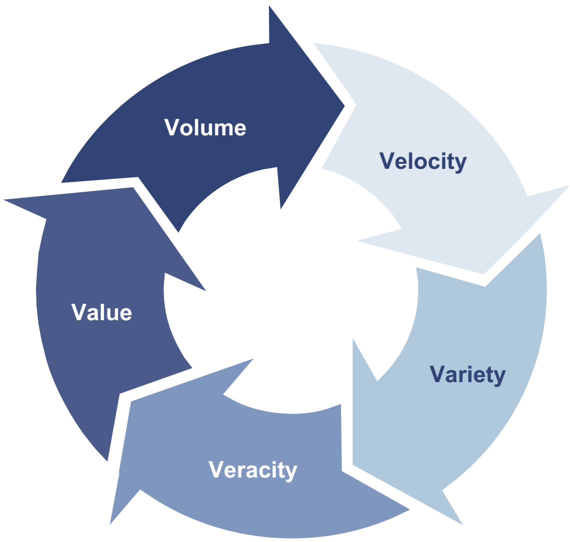

Fig. 2.4 The five Vs of big data (Authors' own figure)

- **Volume** (in terms of data volume or data set)
  "Volume" describes the amount of data available. This amount is defined by the breadth and depth of the available data. Due to the increasing use of sensors and the connectivity of more and more objects, extensive data streams are generated.
- **Velocity** (in terms of the speed of data generation)
  "Velocity" describes the speed at which data sets are either newly created or existing ones updated, analysed and/or deleted. Today—e.g. due to the increasing use of sensors—many changes can be recorded, documented and, if necessary, evaluated in real-time.
- **Variety** (in terms of the multitude of data sources and data formats)
  "Variety" refers to the large number of internal and external data sources that have to be processed—often simultaneously—in the course of AI applications. "Variety" also refers to the large number of different data formats (such as structured, partial and non-structured data as well as photos and videos) that need to be evaluated.
- **Veracity** (in terms of the quality of data and data sources)
  "Veracity" refers to the quality of the available data and data sources. In comparison to the additional criterion "value", "veracity" is not about the significance of the data in the sense of semantics, but solely about the formal information content. The quality of the data in "veracity" can be described with the following dimensions:

  - **Correctness** (in terms of freedom from errors)
  - **Completeness** (in terms of coverage of all relevant fields)
  - **Consistency** (in terms of freedom from contradictions)
  - **Timeliness** (in terms of the validity of the data over time)

  This also involves the question of the trustworthiness of the data, in terms of freedom from systematic distortions. Here, it is particularly important to critically evaluate the statements made by **pro-domo sources**. "Pro-domo" literally means "for the house" and in the figurative sense "in one's own cause" or "for one's own benefit". If a national association of the automotive industry presents certain findings, it can be assumed that these statements are influenced by the agenda of the automotive industry. Therefore they may contain a (partial) "distortion". This also applies to many publications by companies that want to present their achievements in a positive light. If these effects are not taken into account—even with the most sophisticated algorithms—the GIGO effect can occur: "garbage in garbage out" or colloquially "shit in shit out". A shocking example of this is the chatbot *Tay* used by *Microsoft* in 2016 (cf. Sect. 4.1.2).
- **Value** (in terms of the relevance of the data)
  "Value" refers to the relevance of the data with regard to a specific application.

The relevance and interaction of these criteria will be illustrated by an AI-supported automobile. Already today, a connected car generates a data volume of approx. 25 gigabytes per hour (**volume**). This data is created and changed in real-time and must—partly—be processed in real-time, too (**velocity**).

An autonomously driving car must simultaneously evaluate data on the weather, oncoming/current traffic information, road conditions, destination and much more. This data is available in structured, semi-structured and unstructured form. In addition, photos and videos must be continuously evaluated (**variety**). It is important that the processed information about traffic jams refer to the selected route—and that the traffic jam did not dissipate an hour ago. In addition, the sensors must not be dirty, because otherwise they send incorrect data (**veracity**). Finally, the data must be relevant to the vehicle. In this sense, traffic jam warnings on routes that are not used at all are not helpful. This also applies to weather information relating to areas not affected by the vehicle. The reference to speed traps on roads that are not used is also misleading (**value**).

Memory Box
Mastering big data's five Vs is the ultimate challenge for Artificial Intelligence. The quality of data handling has a direct impact on the quality of all applications based on it.

Figure 2.5 shows the **development of the data volume**. Here it becomes clear that an exponential development takes place concerning the availability of data. For AI applications, it is of central importance to ensure that the various data sources and data categories are connected.

What are the most important **data sources** behind this exponential growth in data volumes in Fig. 2.5? On the one hand, there are the **things and processes** themselves that generate more and more data about their own use (often via the already addressed sensors). In their "smart" form (i.e. connected via the Internet) they make their data available via the Internet as Smart Watch, Smart Home, Smart Refrigerator, etc. Also in the use of digital processes, such as streaming services from *Spotify*, *Maxdome* or *Netflix*, a large amount of data about the behavior of

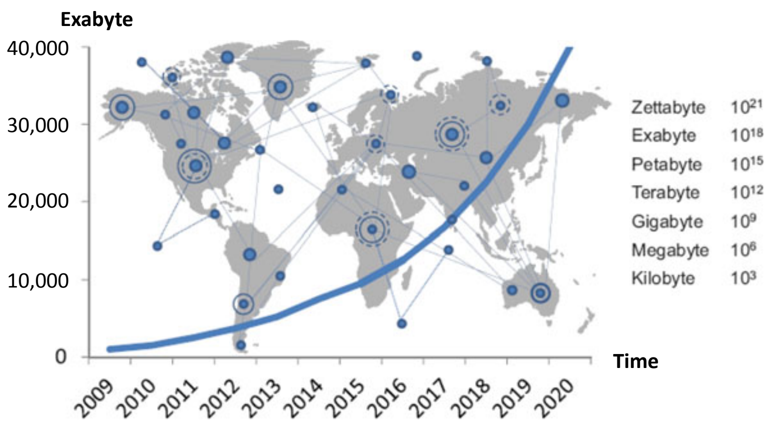

Fig. 2.5 Big data—development of the global data volume in exabytes. *Source* Adapted from Gantz and Reinsel (2012, p. 3) and Turner, Gantz, Reinsel and Minton (2014)

users is generated. The spectrum ranges from the type of content seen or heard, to the time and place, to the information at which scene viewers or listeners interrupted the streaming process.

On the other hand, **humans** also create and share tons of data. Global communication is still dominated by e-mail. To give you an idea of the dimensions you can see below which communication channels are used how intensively. The figures show the activity level per 60 s in the Internet (cf. Desjardins, 2018):

- 187 million emails sent
- 38 million *WhatsApp* messages
- 18 million text messages
- 4.3 million *YouTube* videos viewed
- 3.7 million search queries at *Google*
- 2.4 million snaps created
- 1.1 million *Tinder* swipes
- 0.973 *Facebook* logins
- 0.481 tweets sent
- 0.375 app downloads
- 0.266 h watched at *Netflix*
- 0.174 scrolling *Instagram*

Here—theoretically—an almost unlimited data potential exists, which is relevant for AI applications. Here, not only the content of the messages is relevant, but also the meta-data connected with it. These "data about data" say, who, when, from where and with whom has communicated for how long (e.g. in telephone calls—regardless of the content of the call). In *Google* searches—in addition to the content—it is recorded by which device, in which intensity, with which result and for how long the search was carried out. All these data form the so-called **digital shadow** that we cast in all our online activities—whether we like it or not. This kind of data also belongs to the gigantic data flows that is so exciting for AI applications—when you have access to it.

These developments are based on **Zuckerberg's Law** (Hansell, 2008):

> I would expect that next year, people will share twice as much information as they share this year, and the year after, they will be sharing twice as much as they did the year before. That means that people are using Facebook, and the applications and the ecosystem, more and more.

Actually, this is a wonderful prerequisite for the development of high-performance AI systems. We have to consider that politicians in Europe are enthusiastically discussing the General Data Protection Regulation (GDPR), which came into force on 25 May 2018. Here, the milestone is declared that the comprehensive use of data by companies has finally been prevented. Large budgets and a lot of energy have been invested in the development of processes in order to comply with the "wonderful" principle of the GDPR "**prohibition with**

reservation of permission" as well as the rules "**privacy by design**", "**privacy by default**" and "**data scarcity**".

Many people overlook what was already described in 2009 as the **law of the disproportionality of information**: "The more information there is about a consumer or a decision-maker or a company, the more precisely offers can be placed. This means that we need more information about leads and customers in order to provide them with more relevant information" (Kreutzer, 2009, p. 69). This principle applies in particular to the use of Artificial Intelligence!

Therefore, it is very questionable whether the **data scarcity** demanded by the GDPR is the right way if Europe wants to play in the first league when it comes to Artificial Intelligence. Even though it has already been said many times, it is not wrong:

- **Data is the new oil!**
- **Who owns the data, owns the business, owns the industry!**

Europe has just decided that this data stream will no longer be fed to the pipelines of active companies, but only drop by drop. In addition, companies will now inevitably have to deal with the legally compliant implementation of the GDPR. On the one hand, this paralyzes existing business processes, where a company has to deal permanently with the fact in which way we can still get in contact with a customer and save their data. On the other hand, it distracts the view from other important topics—such as the strategic confrontation with Artificial Intelligence! Against this background, how can Artificial Intelligence be brought to success if its performance depends on the available information?

Food for Thought

Shoshana Zuboff, emeritus professor at Harvard Business School, coined the term **Surveillance Capitalism** for the emerging developments. She understands it as "… a mutation of modern capitalism. Its raw material is data obtained from the monitoring of human behavior. This data about how someone behaves transforms it into forecasts about how someone will behave—and these forecasts are sold in new markets. Surveillance Capitalism has its roots in the digital milieu and dominates it today. It rose to dominance because it opened the first efficient way to online monetarization by quickly and reliably transforming investments into capital. …

Surveillance Capitalism… must penetrate ever deeper into our everyday life, our personality, our emotions, in order to predict our future behavior. …

In Surveillance Capitalism… we are hardly customers and employees any more, but first and foremost information sources, data material of an apparatus whose functionalities remain largely hidden to us. It is not capitalism for us, it is *about us*. It watches us to develop its products. …

It is wrong to say: 'They scan my experiences, I have nothing to hide'. I say: Who has nothing to hide, is nothing. Our inner life, our private experiences, attitudes, feelings and desires are what make us human beings. They are our moral home. (Zuboff, 2018a, p. 68; 2018b; translated by the authors).

Reading Tip
If you want to deepen this topic, we recommend the book by Internet pioneer *Jaron Lanier* "*Ten reasons why you need to delete your social media accounts immediately*". *Lanier* groups his remarks around the term *BUMMER*. This acronym stands for "*Behaviors of Users Modified and Made into an Empire for Rent*". Interesting material to think about.

2.5 New Technologies

New technologies play a particularly important role **in exploiting the data potential** described above. They enable new business models, e.g. based on the Internet of Things or the Internet of Everything (cf. in-depth Sect. 2.3). At the same time, new technologies also embody threatening risks if companies do not recognize their relevance for users and do not rely quickly enough on the corresponding technologies. Then occurs the phenomenon of "selection" of business models that can no longer survive, known as **Digital Darwinism** (cf. in-depth Kreutzer & Land, 2016).

For companies and you as a reader, this goes hand in hand with the question of which technologies should be the focus of attention—and which can be neglected? An important orientation guide for companies is provided by *Gartner*'s annually updated **hype cycle for new technologies**. This shows the **phase of the lifecycle** in which cross-industry relevant technologies are located. These technological life phases are defined by *Gartner* on the basis of the **expectations** connected with each technology (cf. Fig. 2.6).

Gartner defines five different phases in terms of technology expectations, which **provide information on the state of expectations and the market uptake of new technologies**.

- **Innovation trigger**
  In this phase, the first ideas of new technologies are published and taken up by the media. At this early stage, it is not yet possible to predict whether these technologies will be used sustainably.
- **Peak of inflated expectations**
  In this phase, the first success stories are published, which drives further expectations for a new technology. At the same time, initial failures in the use of the technology can become visible, which push expectations to their limits. The use of technology is still limited to a few companies.

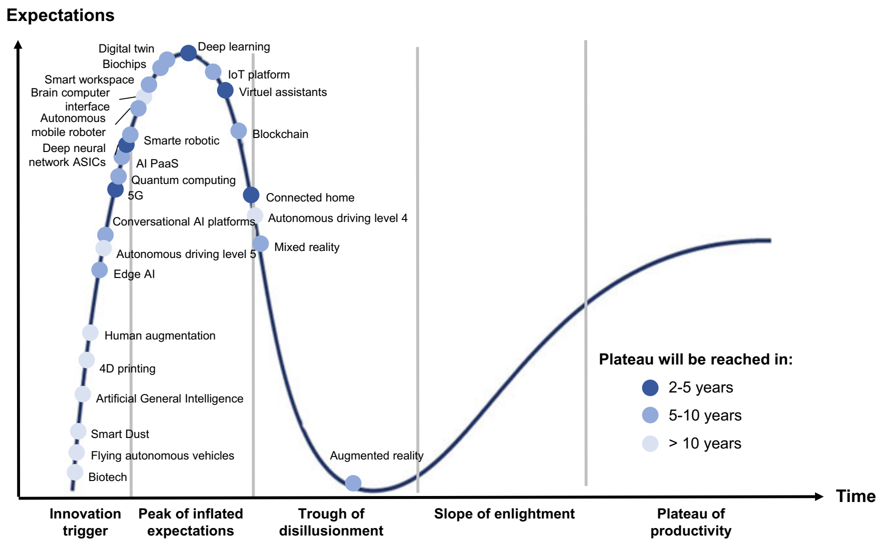

Fig. 2.6 Gartner hype cycle for new technologies. *Source* Adapted from Gartner (2018)

- **Trough of disillusionment**
  This trough in the technological life cycle is based on the insight that many expectations of new "miracle weapons" were not fulfilled. In this phase the wheat separates from the chaff!
- **Slope of enlightenment**
  In this phase more and more companies are seeing how technology can be put to beneficial use. Technological developments of the second and third generation of the initial technology are offered and increasingly taken up by innovation-open enterprises and integrated into the workflow.
- **Plateau of productivity**
  The technology is now widely used because its advantages are not only visible but also pay off comprehensively. The use as mainstream technology is pre-designed. The use in more and more companies and application areas is only a question of time.

In addition, *Gartner* presents a hype-cycle **forecast** of when the productivity platform is likely to be reached. This can be seen in Fig. 2.6 from the different brightness levels of the individual technologies.

Mike Walter, Research Vice President at Gartner (2018), aptly summarized how to deal with the developments shown in Fig. 2.6: "As a technology leader, you will continue to be faced with rapidly accelerating technology innovations that will profoundly impact the way you deal with your workforce, customers and partners. The trends exposed by these emerging technologies are poised to be the next most

impactful technologies that have the potential to disrupt your business, and must be actively monitored by your executive teams."

Figure 2.7 shows which individual developments belong to the trends defined by Gartner (2018). In this work, the aspects that belong in the context of Artificial Intelligence are deepened.

Gartner's **2018** ***hype cycle*** (2018) is dominated by the following five major **technological trends** (cf. Fig. 2.7):

- **Democratized Artificial Intelligence**
  The trend with the greatest disruptive force goes hand in hand with the development of Artificial Intelligence. Cloud computing, open source and a "maker" community are making corresponding applications available on an ever-increasing scale. Companies that have set off as first movers will benefit from the continuous development of the technology. The greatest force for change comes from units in which developers, data scientists and AI architects—even across national and industry boundaries—work together to develop convincing AI applications. As a result, more and more areas of life are being penetrated by AI solutions.

The **Deep Neural Nets (Deep Learning)** topic area, which is at the peak of expectations, will contribute to increase the performance of AI systems (cf. Fig. 2.6). The offers of **virtual personal assistants** (such as *Alexa* and *Google Home*) as well as **robots for everyday use** (such as vacuuming, wiping and lawn mowing) will drive this democratization forward. Here, there will be also (more and more) **intelligent robots** working hand in hand with people (so-called cobots) which provide room service or also perform demanding tasks in the production and logistics chain. They will support or replace the human workforce.

Democratized AI	Digitalisized ecosystems	Do-it-yourself biohacking	Transparently immersive experiences	Ubiquitous infrastructure
• AI PaaS • Artificial General Intelligence • Autonomous driving level 4 • Autonomous driving level 5 • Autonomous mobile robots • Conversational AI platforms • Deep neural nets • Flying autonomous vehicles • Smart robots • Virtual assistants	• Blockchain • Blockchain for data security • Digital twin • IoT platform	• Biochips • Biotech – cultured or artificial tissue • Brain computer interface • Exoskeletons • Augmented reality • Mixed reality • Smart fabrics	• 4D printing • Connected home • Self-healing system technology • Smart dust • Smart workspace	• 5G • Edge AI • Deep neural networks ASICs • Neuromorphic hardware • Quantum computing

Fig. 2.7 *Gartner*'s Emerging Technology Trends 2018. *Source* Adapted from Gartner (2018)

For this purpose, **conversation AI platforms** (also called conversational user interfaces, CUIs) are used, which are based on various AI technologies. However, it is already foreseeable that graphical user interfaces (GUIs), which have dominated until now, will be outdated soon. These interfaces serve the communication between humans on the one hand and a machine or a system on the other hand. CUI is about speech-based systems that enable communication between human and machine and correspond to a human dialog.

This category also includes the different stages of autonomous vehicles. **Autonomous driving level 4** describes vehicles that can drive to a high degree—but not alone—without human interaction. They can be used in demarcated areas. Such vehicles are expected to be introduced into the market in the next decade. **Autonomous driving level 5** indicates vehicles that act autonomously in all situations and conditions. The corresponding vehicles do not require a steering wheel or pedals. Such "cars" represent an additional working and living space for people.

First of all, it is about **mastering the technology of autonomous locomotion**, which—according to Gartner (2018)—still requires at least five to ten years of development. **Autonomous flying vehicles** will not only serve to transport people but will also transport medical supplies and food. Completely autonomous flying vehicles can partly be developed more easily than autonomous vehicles on board. On the one hand, the airspace is already heavily monitored today. On the other hand, humans are largely eliminated as an "unpredictable disturbance factor" in the air (except for gliders, hang-gliders and parachutists!). Many regulatory and social challenges have to be overcome during development, ranging from the placement of landing sites to the avoidance of crashes. Such **autonomous flying aircrafts** are one of 17 technologies newly included in the *Gartner Hype Cycle for Emerging Technologies* 2018 (cf. Fig. 2.6).

Artificial General Intelligence (AGI; cf. Fig. 2.6) is also found at the very beginning of *Gartner*'s technological life cycle. At its core, this refers to the reproduction of human intelligence. The goal is that a system can successfully master any intellectual task that a human being is capable of. AGI is the epitome of "strong Artificial Intelligence" (cf. Fig. 1.5; cf. Steunebrink, Wang, Goertzel, 2016).

Memory Box

Artificial General Intelligence aims to elaborate the principles of intelligence that work independently from a specific task or predefined context. These principles are intended to enable machines not only to perform the most intellectual task a person is capable of, but even to go beyond.

The **brain computer interface** (BCI), which is on its way to the peak of the technology life cycle, can contribute to this development (cf. Fig. 2.6). For this, the terms **brain machine interface** (BMI) or **brain computer** are also used. At its core, it is a human-machine interface that enables a direct connection between brain and computer without activating the peripheral nervous system. For this purpose, the electrical brain activities are recorded. This can be done without surgery

(non-invasive) via the **EEG** (electroencephalography). For this purpose, the test person has to wear a hood with a large number of cables, which makes it extremely difficult concerning the usability of a corresponding application. In the future, optimized headbands may be able to help. The **fMRI** (functional magnetic resonance imaging) system for recording brain activity does not require any intervention. For this purpose, the person must be driven into an appropriate device in order to record the brain activities. The so-called invasive procedures do not require this high level of mechanical effort. But for this purpose, **electrodes are implanted** in the test persons´ brain to measure brain waves directly there. However, this requires direct intervention in the body.

The basis of these developments is the fact that the **imagination of a certain action** triggers measurable changes in **electrical brain activity**. Thus, a brain computer interface can be used to determine which changes in brain activity are correlated with which kind of ideas (cf. Bauer & Vukelic, 2018). The knowledge about relationships gained in that way can be used as **control signals for a wide variety of applications**. Until today, this communication has only succeeded in one direction ("single-track usage"). Humans can communicate something to the machine through their thoughts—but the computer cannot yet lead any corresponding thoughts directly back to the brain ("two-track usage"). So far, humans (still) depend on their proven sensory organs to recognize reactions of the system. It is an open question whether this will always remain so and whether we want a direct feedback into the brain.

Current developments indicate that at least "single-track" **brain computer interfaces** could conquer the market in a few years. The origin of these applications lays, among other things, in the possibility of providing people with physical disabilities with an access to interaction via computers or wheelchairs. Thought-based control replaces the mouse, keyboard and touch screen, which require physical movement (cf. Stallmach, 2017). In the gaming industry, there are already first approaches, where the game is only controlled per thoughts with the help of VR glasses. At present, it should be noted that users must be connected by means of diodes applied with a contact gel (example of a non-invasive application). In addition, the processing is still very slow, and the error rate is very high. However, intensive research is used to develop solutions suitable for everyday use.

Tesla creator *Elon Musk* also founded *Neuralink*, a company that develops computer chips to connect people directly to Artificial Intelligence. These chips are implanted into the brain in order to go online by thought. Neither the fingers nor the mouth are needed for this, because the corresponding commands are captured directly in the brain. The fact that the company still needs many qualified employees in order to achieve its ambitious goal can be seen from the number of vacancies offered on the Neuralink (cf. 2019) website:

- Digital Designer (Verilog, C/C++)
- Electrical Engineer
- IT Support Specialist
- IT Team Lead

- Operations Accountant/Bookkeeper
- Process Engineer
- Recruiting Coordinator
- Senior CNC Machinist
- Senior Software Security Engineer
- Software Engineer, Backend
- Software Engineer, Roboticist

Facebook is also looking for ways to use thinking directly without using spoken or written language. The Brandenburg-based company *Neurable* is also developing a solution that will enable "thought transfer without gel". The contact surface should be a tiny device in the ear (cf. Werner, 2018). *Facebook* already announced in 2017 that a team of 60 engineers is working on the development of brain computer interfaces. Again, it is the goal to write text messages through pure **thought control** (cf. Constine, 2017). It is already possible today for a person to think only of moving the thumb of a robot arm—and it moves. Electrodes, which are either implanted in the brain or applied to the head from the outside, measure the brain activity associated with the thought. This is transmitted to an AI system, which calculates the intended movement from it (cf. Steiner, 2018, p. 28).

Imagine an everyday life where you can exchange thoughts with your friends in the subway by pure thought transfer. Only 15 years ago we could hardly have imagined this for an exchange of messages via smartphones. Brain computer interfaces are another example of how AI applications will revolutionize our everyday lives.

Food for Thought

Forecast by Internet investor *Fabian Westerheide*: "In five years every machine will be controlled by speech, possibly in ten years by thinking. This will be the biggest acceleration boost ever" (Budras, 2018, p. 21).

- **Digitalized Ecosystems**

New technologies require support from new technological foundations and more dynamic ecosystems (cf. Fig. 2.7). **Mastering these ecosystems** requires new business strategies, such as the transition to platform-based business opportunities. This means that more and more previously isolated technical infrastructure solutions can be destroyed. The topic of blockchains could play a decisive role in data security. It has the potential to increase resilience, reliability, transparency and trust in centralized systems.

The increasingly important IoT or IoE platforms also belong in this area. **Internet of Things platforms** primarily link things together, whereby **Internet of Everything platforms** open far more applications that also link people, processes and data (cf. Fig. 2.3).

This trend also includes the **development of digital twins**. Here, the virtual (digital) representation of a real object is marked by a three-dimensional CAD model, so that a virtual mirror image is created. Today, such virtual mirror images are increasingly available of machines, complex production facilities, cruise ships, high-speed trains and aircrafts. AI applications can not only be used to simulate design, production and further development. The technical condition, wear, maintenance and necessary repairs can also be simulated digitally and predicted accordingly. This makes maintenance work much easier and reduces downtimes considerably. Gartner (2018) estimates that several hundred million physical objects will receive a digital twin within the next five years.

Digital twins are used in the B2C market, too. At *H&M*, specialists are working on a program called *Perfect Fit*. With its help, the customer can be scanned at home. Afterwards, the **digital twin** can try on fashion online to improve user experience and at the same time reduce the return quota (cf. Salden, 2018, p. 59).

- **Do-it-yourself biohacking/bodyhacking**
  2018 is seen by Gartner (2018) as the **beginning of a "transhuman" age**, in which hacking biology and "extending" humans increase in popularity and availability (cf. Fig. 2.7). This ranges from simple diagnostics to neuronal implants and is the subject of legal and social questions on ethics and humanity.

Biohacking or **bodyhacking** refers to the transfer of the idea of IT hacks to biological systems and here primarily to the human body (usually by the affected person himself), but also to the entire biosphere. IT hacking is the unauthorized intrusion into a computer or network. The persons involved in such hacking activities are referred to as hackers. These hackers can modify system or security features to achieve a goal that differs from the original purpose of the system. Accordingly, biohacking strives for body changes. People experiment with implants and other methods that interfere with a person's physical processes. An introduction to this can be so-called self-medical hacks, e.g. independently performed DNA tests. Based on a multitude of data, different **forms of physical self-optimization** can be developed.

In our opinion, a particularly curious example of self-optimization is the **use of eye drops** to help people achieve **night vision**. A substance called *Chlorine e6* (*Ce6*) was administered to the test persons for this purpose. Subsequent tests actually showed that the people treated in this way were able to perceive objects much better in darkness than their peers. In everyday life the test persons have to protect their eyes with black contact lenses due to the increased light perception (cf. WinFuture, 2019). Imitation not recommended!

Memory Box
Biohacking can also be carried out by third parties. This makes biohacking increasingly similar to IT hacking. British scientists have succeeded in extracting

secret numbers (e.g. for a credit card) from brain waves and disclosing them. Consequently, there is a risk that data extracted from the brain waves will migrate from the clinical to the commercial domain and be abused there (cf. Ienca, 2018, p. 11).

Biochips offer the possibility to detect diseases from cancer to smallpox before the patient even develops symptoms. These chips consist of a series of molecular sensors on the chip surface that can analyse biological elements and chemicals. **Biotech** means artificially bred and biologically inspired muscles. Although this technology is still under development, it could eventually lead to skin and tissue growing over the exterior of a robot and making it pressure sensitive. This would allow the next step to be taken towards humanoid robots.

Another field of biohacking is the development of **exoskeletons**; "exo" stands for "outside" in this term. An exoskeleton is the outer support structure for an organism. These are robots mounted on the outside of the body that can support or amplify the movements of the wearer. To this end, appropriate motors are used. Applications can be found in medicine to enable paraplegics to walk. In addition, such exoskeletons are also applied in production or logistics to facilitate overhead work or the lifting of heavy objects. Corresponding solutions are offered by the German manufacturers *German Bionic* and *Ottobock Industrials*. In an expansion stage these can be controlled by thoughts. For this purpose, implants or receivers for brain signal lying on the cerebral cortex are used (cf. Goetz, 2018, pp. 164–167).

The Israeli company *OrCam* has developed a small device to help visually impaired people. A tiny camera and a loudspeaker are attached to glasses. If the user now points to a text in the form of product descriptions, scoreboards or signs, NLP enables the system to capture the very heterogeneous text information and reproduce it in the form of spoken language (cf. Brynjolfsson & McAfee, 2014, p. 114).

This area also includes the development of **human augmentation/human enhancement**. This AI field aims to expand and increase human performance. At its core—as strange as it may sound—is the "optimization of the human being" through artificial systems. As already mentioned, this can be done for sick people through medical interventions with active substances, aids and body parts. Healthy people can also be "optimized" through appropriate applications and integration and/or connecting with technologies. Here the topic of **transhumanism** is addressed—as it were the continuation of human development through the use of scientific and technical means. On the one hand, this research is based on the tradition of humanism. On the other hand, one tries to overcome precisely the state of the natural and to advance the artificial. The focus is on the already mentioned cyborg—the fusion of human (or animal) with a machine (cf. Bendel, 2019).

Injected chips—of the around 70,000 cyborgs that can be found worldwide today—are already replacing identity papers, boarding passes and keys if the interaction partners have installed a corresponding radio interface. An injected chip can also be used to speed up entrance control in the office and computer registration. In conjunction with data from fitness trackers, blood glucose values and other

biometric data, heart attack warnings can be determined, and push messages sent when a break is required. Futurologists assume that injected chips can revolutionize everyday life—especially for highly active managers—in a similar way to the smartphone. Today there are already **sets for self-chipping**, whereby packages with syringes can already be purchased for US-$56 (cf. Obmann, 2018, p. 58f). In our opinion, human intelligence is required here in order to check to what extent the technological possibilities should actually be used.

A disadvantage is that no dominant chip system has yet emerged, so that **cyborg pioneers** sometimes have two, three or more injected chips to take advantage of the possibilities that already exist today. Perhaps the *VivoKey* chip implant will succeed in becoming a dominant design. After all, this chip has a larger memory and an additional microprocessor, so that many more fields of application can be opened up. These include forgery-proof signatures, the processing of financial transactions, online shopping and cashless payment (cf. VivoKey, 2019).

As *Elon Musk* put it so beautifully: "We must all become cyborgs if we want to survive the inevitable revolt of the robots" (cf. Obmann, 2018, p. 58).

Memory Box

A small **thought-provoking impulse for all cyborg fans**: During an MRI examination, the strong magnetic field used erases all the data on the chip. You should therefore have a recovery set and an implant ID card that certifies that you are safe for such an examination. As long as the chip is not made of precious metal, it will heat up more or less strongly.

- **Creation of immersive experiences**
  AI applications will enable **new work and life experiences**. This can lead to immersion (cf. Fig. 2.8). This describes the effect that the stimuli provided (e.g.

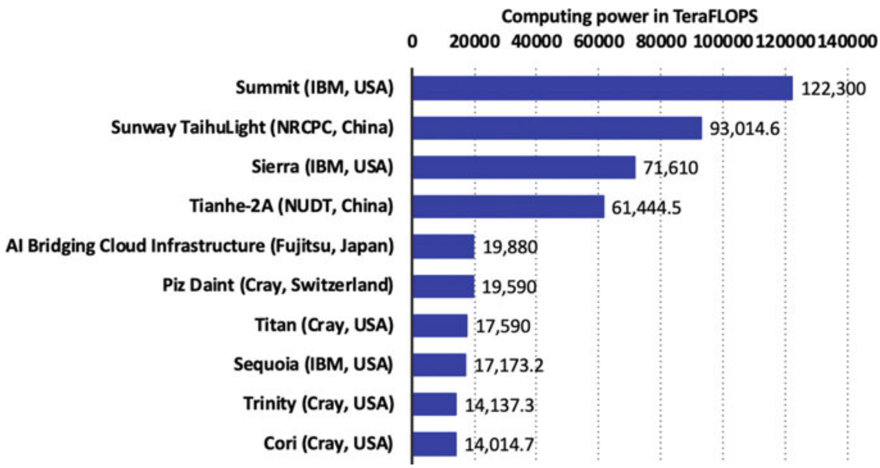

Fig. 2.8 Computing power of the world's most powerful supercomputers—June 2018 (in TeraFLOPS). *Source* Statista (2018, p. 22)

via virtual reality/VR) displace the real background to such an extent that the virtual environment is now perceived as “real”. In computer games with VR, this effect is already comprehensively achieved when a **haptic glove** is used. Such a glove can transfer hand movements into virtual reality by finger tracking. In this way, objects can be felt and touched in virtual reality. By exerting pressure over the already tested exoskeleton, haptic feedback is also provided.

The immersion can be amplified by a **haptic jacket** that can transmit pressure to the body of the respective user through the use of different motors (use of so-called stimuli points). Thus, not only the sound of VR games can be felt physically, but also strokes in a physical confrontation. By the use of sensors in such a jacket—or further developed as a full-body suit—it is also possible to recognize very precisely how and where the user moves.

Other technologies that are used today in intelligent work areas are increasingly focusing on people. The boundaries between people and things can blur. Simple applications are **electronic whiteboards** that automatically capture meeting notes. In addition, sensors can help to provide employees with personalized information based on location and task. **Augmented reality systems** can be used for maintenance purposes (cf. Sect. 5.3). In other applications, office supplies can interact directly with IT platforms and trigger various processes, such as ordering.

In the private environment, smart houses will connect a wide variety of devices, sensors, tools and platforms. In that way, they can learn something about the way the house is used by the people living there. This is the basis for ever more intelligent systems that create **contextualized and personalized experiences** and thus immerse deeper and deeper into the reality of people’s lives.

- **Ubiquitous infrastructure**
  It must be noted that “infrastructure” alone in many areas is no longer a key resource for differentiation in competition (cf. Fig. 2.8). The wide variety of **Everything as a service** offers make this clear. Today there is already a wide range of **x as a service**:

  – Backup as a service (BaaS)
  – Data-Intensive-Computing as a service (DICaaS)
  – High-Performance-Computing as a service (HPCaaS)
  – Humans as a service (HuaaS) as description for crowd sourcing
  – Infrastructure as a service (IaaS)
  – Mobility as a service (MaaS)
  – Music as a service (MUaas)
  – Platform as a service (PaaS)
  – Software as a service (SaaS)
  – Traffic as a service/Transportation as a service (TaaS)

A seemingly limitless infrastructure (including human labor) that is always available in many areas has massively changed the corporate landscape—and will continue to do so!

Memory Box
In former times drilling machines were sold, today holes are sold!

The **Edge AI** mentioned in Fig. 2.8 is—in contrast to cloud computing—a form of decentralized, AI-supported data processing "at the edge of the network". AI applications and data are moved away from the central nodes (e.g. data centers) and to the edges of the network. In order to relieve the networks of the transmission of very high data volumes, data streams are processed more strongly on site. This can be a device itself, a factory or an Internet of Things or Internet of Everything platform.

Quantum computing, as mentioned earlier, will work exponentially faster than traditional computers. In the future, this technology will have a massive impact on machine learning, encryption technology and data analysis (including text and image analysis). This will need to provide the additional processing power required for many AI applications.

It becomes clear that many of the technologies mentioned in Fig. 2.8 can be assigned to the AI topic area. Their successive advance as well as the development of further fields of application lead to an ever more **comprehensive AI penetration** of the private and working worlds.

Food for Thought
Now your **entrepreneurial spirit** is required to develop profitable business cases from technologies and technical use cases! Because one thing is certain—AI applications will change the world once again in the long term. This is due to the fact that **AI technologies** have a particularly high level of innovation and consequently a large **disruptive potential**. Therefore, it has become unavoidable to deal with AI technologies during the **digital transformation**!

As already indicated, success in the **global AI race** depends on the **availability of high-quality data** (cf. Sect. 2.4) and correspondingly powerful computers. For this reason, we take a look where the world's most powerful computers are located today (cf. Fig. 2.8). The computing power is shown in **TeraFLOPS**. FLOPS stands for Floating Point Operations Per Second. "Operations" refers to adding and multiplying numbers, while "floating point" stands for the usual IT representation of numbers. A FLOPS indicates how many calculations a computer can perform per second. The larger this number is, the more powerful the computer is. If a computer has a computing power of one TeraFLOPS (TFLOPS), this computer can perform 1000,000,000,000 operations per second.

A glance at the **locations of the so-called supercomputers** shows that the USA, with six such computers, ranks first, closely followed by China. Switzerland is the only European country in the Top 10.

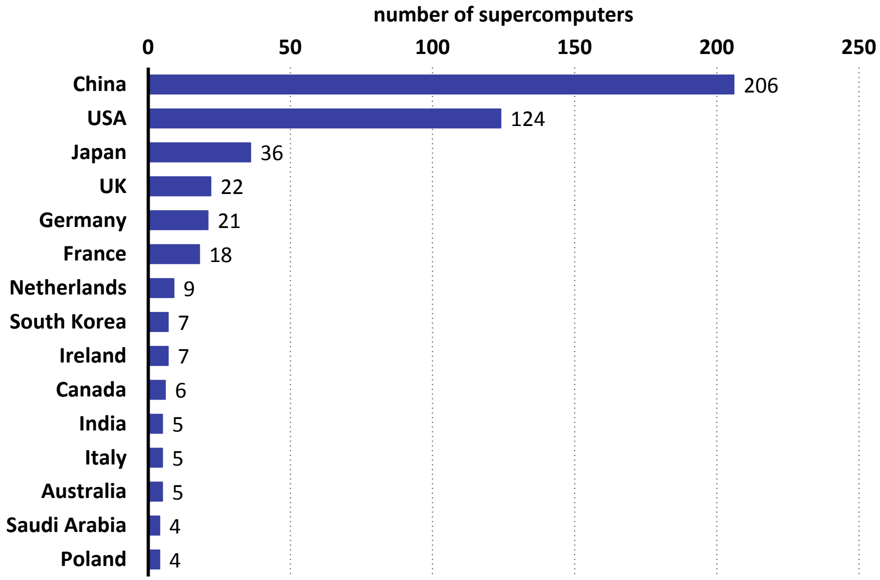

Fig. 2.9 Locations of the 500 most powerful supercomputers worldwide—June 2018. *Source* Statista (2018, p. 23)

A look at the **worldwide locations of the 500 most powerful supercomputers** in Fig. 2.9 is also exciting. This again shows the dominance of China. As already mentioned, China in its master plan "Made in China 2025" has defined Artificial Intelligence as a central field of action for achieving a global leadership role. China is well on the way to achieving this goal. Germany achieves in this country ranking —for one of the leading industrial nations of the world—a not very respectable 5th place!

Even if all supercomputers stationed in Europe are added up to 86, they are trumped by the USA—not to mention the equipment in China!

Against this background, it becomes clear why ten partners from science and industry joined forces in Europe in 2018 to build a **100-Qubit computer** called *OpenSuperQ* at research center Jülich by the end of 2021. By doing so, European researchers want to ensure that they are not completely left behind in the global race for extremely high-performance quantum computers. This project is part of an **EU flagship program** to promote research into quantum technologies in Europe. The *OpenSuperQ* is intended to accelerate the simulation of processes in chemistry and materials science as well as machine learning in Artificial Intelligence. **Quantum technology** is about to make its breakthrough into everyday technology. The use of quantum computers can cope with computing tasks that conventional computers have failed to perform so far. The quantum computer to be developed should have 100 quantum or qubits and with open source software via a cloud should enable access to any interested application (cf. Heise, 2018).

An important prerequisite for the technologies described above to be able to develop their (positive) effects is a high-performance mobile network that covers as much of the country as possible. The **5G mobile network** standard is of particular importance here; "5" stands for the 5th generation. This new standard can be described by the following features:

- 100 times faster data transfer than 4G networks (transfer rates up to 10 Gbits/second)
- Use of higher frequency ranges
- Increased frequency capacity enables higher data throughput
- Real-time transmission supports control of 100 billion mobile devices worldwide
- Extremely short latency times (in the sense of reaction, delay or transmission time) of one millisecond even over longer distances (the human eye takes about ten times as long to transmit information to the brain); the latency time is thus ten times shorter than with 4G.
- Significant reduction of energy consumption in data transmission compared to 4G
- 5G can connect a million devices per square kilometer; ten times more than 4G

The introduction of 5G will enable not only real-time machine-to-machine communication, but also human-to-machine communication. This can support new forms of interaction. In addition to the network infrastructure, an important prerequisite for this is the development of common standards for data transmission.

2.6 Investment in Artificial Intelligence

The importance that individual companies attach to Artificial Intelligence is made clear by the statement by *Google* CEO *Sundar Pichai*. He now calls *Google* an **"AI-first" company**. Thereafter, all further developments will be prioritized with the focus on further expanding *Google*'s AI competence. Why this is so, a further statement by *Pichai* makes clear: "AI is more important than fire or electricity."

What **investments in Artificial Intelligence** are made in total? According to a study by McKinsey (2018, p. 5), companies worldwide invested between US-$26 and 39 billion in Artificial Intelligence in 2016. The "Tech-Giants" (*Alphabet, Amazon, Apple, Facebook, IBM, Microsoft*) account for between US-$20 and 30 billion. Startups invested between US-$6 and 9 billion. In total, the external AI investment has tripled since the year 2013.

The **EU Commission** has also set itself the goal of investing more in Artificial Intelligence in order to make up for the gap between Europe and the USA, and China in particular. Investments of US-$1.7 billion are to contribute to this. At the same time, Digital Commissioner *Mariya Gabriel* points out that in addition to investments and a clear ethical and legal framework, there is also a need for more publicly accessible data. Private investments in AI research projects are currently three times higher in Asia and five to six times higher in the USA than in Europe. In

order to mobilize additional private funds, the EU Commission will make the above-mentioned US-$1.7 billion available. Europe would rather need US-$23 billion by 2020 (cf. Zeit, 2018).

The fact that, in addition to the financial resources, the necessary **mindset** has also been lacking so far is underlined by further results determined by McKinsey (2018, p. 4). These are based on a survey of 3000 C-level managers (AI-related) in ten countries (China, Canada, France, Germany, Italy, Japan, Sweden, South Korea, the United Kingdom and the USA) and 14 industries:

- In general, **AI acceptance** in companies outside the technology sector is still at an **early, often only experimental stage**.
- Only 20% of respondents use **AI-related technologies on a larger scale or in a core area of the company**.
- Many companies are **uncertain about relevant business cases and/or the achievable return on investment**.
- A detailed analysis of more than 160 use cases shows that Artificial Intelligence is in **commercial use** only in 12% of cases.

Chapter 10 shows how the **mindset of employees** and the possibilities for internal use of Artificial Intelligence can be changed. It is true: Since the first industrial revolution, **technological progress** has brought us a permanent and ever more rapidly growing **increase in prosperity**. The paradox is that after the introduction of pioneering new technologies—such as the introduction of electric light in factories at the end of the nineteenth century and the arrival of computers in the 1990s—**productivity initially slowed down**. This connection was highlighted by *Chad Syverson*, economist at the *University of Chicago*. Accordingly, it took several years before there was an actual increase in productivity. It has been shown that the basic technology only showed positive effects when supplemented by innovations (cf. Syverson, 2013; Brynjolfsson & McAfee, 2014, pp. 125–127).

Memory Box

Digitalization and AI technologies are not yet success factors per se, which virtually automatically ensure economic growth and social prosperity. Only **AI-based innovations** can tap **growth, efficiency and prosperity potentials**. This requires ideas, budgets, courage as well as creative and committed employees in order to turn great ideas into reality.

Therefore, it is important that the most diverse sciences leave their silos and ivory towers and contribute their knowledge to corresponding **AI networks**. Further development requires a large number of scientists and a comprehensive networking. Which sciences have a special significance for the development of Artificial Intelligence? These include biology, cognitive sciences (such as psychology, philosophy and linguistics), economics, computer science, mathematics and engineering.

Biology provides the basis from which the "ideal image" of AI systems is derived. In order to develop a humanoid robot, comprehensive knowledge of anatomy, psychology and neuroscience is required. After all, a humanoid robot—as already mentioned—should not only be outwardly similar to a human being but should also be able to imitate human behavior and make social decisions. To this end, findings from the **cognitive sciences** are needed, too.

Mathematics, in turn, provides the tools to develop the algorithms of AI technologies. It enables **developers** to write powerful AI programs. **Engineers** interact with these algorithms to implement the cognitive and physical performance of robots and machines. In order to reach market maturity for these developments, it is not least necessary for **economists** to recognize customer needs at an early stage and fertilize the proposed work steps with them. As far as it goes beyond basic research, economists are also decisively responsible for achieving a return on investment (ROI) so that AI investments become profitable in the long term. Figure 2.10 shows how Artificial Intelligence is embedded in sum with its fields of application and methods.

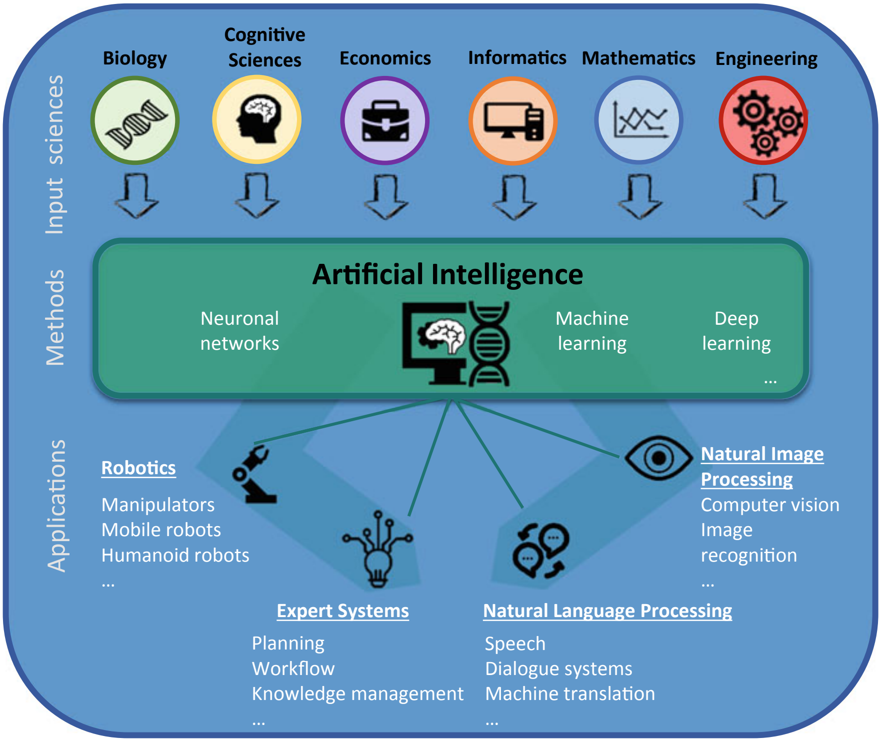

Fig. 2.10 Input sciences, methods and application fields of Artificial Intelligence (Authors' own figure)

Summary

- The **effects of exponentiality** will massively advance the performance of AI applications in the coming years.
- The **digitalization and dematerialization of products, services and processes** offer additional fields of application for Artificial Intelligence.
- The **connectivity of objects, data, processes and organisms** creates new fields of application for AI systems.
- **Comprehensive data pots**—identified by the terms volume, velocity, variety, veracity and value—represent the necessary food for AI developments.
- Many **new technologies** of the *Gartner Hype Cycle* support the AI usage and will successively exploit new areas of application.
- The **AI success on the world markets** stands or falls with the available budgets.

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3 Fields of Application of Artificial Intelligence—Production Area

Make it simple but significant!
Don Draper

Abstract

In this chapter you will see that Artificial Intelligence can unfold its comprehensive effects especially in the field of production. In addition to cost reduction through more efficient use of plants and processes, flexibility in production can also be increased. It is important to implement a digital value chain to install the necessary connections to upstream and downstream service partners. With the support of Artificial Intelligence significant improvements in the relevant KPIs across all stages of the value chain can be achieved.

3.1 Introduction to the Fields of Application

Before we discuss a large number of **AI application areas**, an important aspect must be clarified. Today's AI systems are always designed for **specific tasks**. This means that Artificial Intelligence, which was used to win against the *Go* World Champion, would fail miserably in the game of chess and also in *Jeopardy*. Thus, they are far away from a comprehensive human intelligence.

These restrictions must be taken into account when the following sections demonstrate how possible use cases can be turned into real **business cases**. These should not only be innovative, but also contribute sustainably to the success of the company. Thereby, specific requirements of different industries are taken into consideration. This can provide important impulses for the analysis of your own business processes.

R. T. Kreutzer and M. Sirrenberg, *Understanding Artificial Intelligence*,
Management for Professionals, https://doi.org/10.1007/978-3-030-25271-7_3

In the following, it will become clear that AI integration into products and services can take place on your own. Also processes of procurement, innovation/creation, production, distribution and communication etc. can not only gain efficiency through the integration of Artificial Intelligence, but also provide new benefits for customers.

Memory Box
The **limits of the future use of AI** are not even beginning to be recognized today. Consequently, it is especially your creativity and responsibility that are important to recognize the emerging possibilities early on and to make active use of them.

In the following, exciting **fields of application of Artificial Intelligence** in different industries and different corporate functional areas are shown. Since Artificial Intelligence is a cross-sectional technology, the applications are not oriented towards classical industry or functional boundaries. Rather, they lead to a connectivity across industry and functional boundaries. Nevertheless, we have tried to make a meaningful and reader-friendly allocation both to industries and to entrepreneurial functions.

3.2 Significant Developments in the Production Area

Before the use of Artificial Intelligence in production is discussed, **central developments in production** are presented first (cf. Fig. 3.1). Here it becomes clear that in many areas of Artificial Intelligence great importance is attached to mastering the associated challenges.

At the center of the AI application in the production environment is the so-called **smart factory**. In Germany, the term **Industry 4.0** was coined for this purpose. In essence, it is a question of **connected production technologies**.

Trends	Challenges	Enablers
Small batch sizes – greater variety	Complexity in production with limited predictability of demand	Automation along the entire value chain – across company boundaries
Shorter product lifecycles, faster product launches	Disruptive developments in production – integration of robots – high SW/HW costs	Software for production control via robotics – expertise in robot use – AI
Arbitrage advantages in automation – use of collaborative robots	Balancing the use of humans and robots for cooperative use	Professional human resource management – development of collaborative robots – AI
Increasing demands on the know-how of employees to cope with industry 4.0	Shortage of highly qualified specialists (e.g. data scientists, AI specialists)	Investments in the qualification of our own employees; targeted acquisition of specialists

Fig. 3.1 Important production changes. *Source* Adapted from IFR (2017, pp. 19–24)

Memory Box

Process optimization alone is not the core of Industry 4.0. Artificial Intelligence opens up many more possibilities—far beyond the development of existing processes. It is also about **creating new products and services** and **developing innovative business models**.

3.3 Smart Manufacturing

In **smart manufacturing**, the focus is on achieving the developments described below:

- The boundaries between product design, production processes, supply chain and demand management are being torn down.
- Virtual tracking of plants, processes, resources and products becomes possible.
- Relevant information—along the supply chain, from production sites to demand development—is available in real-time, visually processed and with action impulses.
- A rationalization of business processes as well as an optimization of demand and supply become possible—with high flexibility.

Memory Box

> Smart manufacturing transforms businesses into proactive, autonomic organizations that predict and fix potentially disruptive issues, evolve operations and delight customers, all while increasing the bottom line (O'Marah & Manenti, 2015, p. 3).

This is at least how the desired image can be described, the achievement of which requires hard work and a significant investment.

Figure 3.2 underlines the **importance of smart manufacturing**. It shows that the global market for this manufacturing concept will more than triple in the next six years. Consequently, it is worthwhile to intensively explore the possibilities of smart manufacturing for your company.

Figure 3.3 shows the **extent of the scope of the discussion concerning smart factories**. 200 managers from the industrial sector worldwide were surveyed, which of the following statements on digitalization and digital factories best describes the situation of their own company. The reference point for the responses was the most advanced factory with a relevant production volume.

The **ROI from digital factories and digital concepts** that the experts surveyed expect worldwide is shown in Fig. 3.4. The corresponding question was: "When do you expect your investments in digital factories or digital concepts to pay off?" While a return of "only" 3–14% is expected in the shorter term, expectations for the longer term are impressive at 26–48%. Only those experts were asked about these expectations who were planning or already using corresponding investments. 9% of

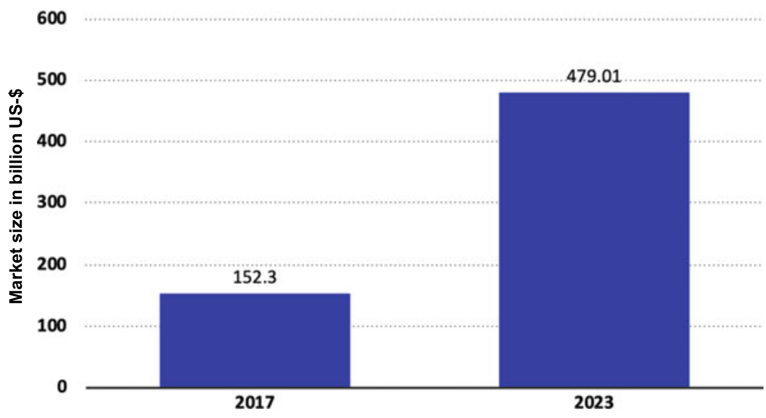

Fig. 3.2 Size of the smart manufacturing market—worldwide in 2017 and 2023 (in US-$ billion). *Source* Based on Zion Market Research, (2017)

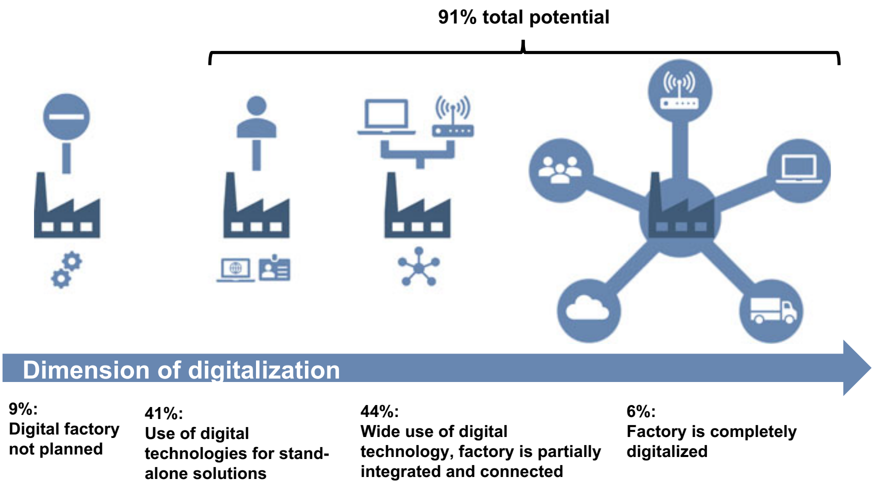

Fig. 3.3 Intensity of worldwide involvement in smart factories. *Source* Adapted from PWC (2017)

respondents did not specify a time horizon for their ROI expectations. This makes it clear that AI use in production requires staying power.

In a visionary design, these factories (production facilities, incl. quality control and logistics systems) organize themselves independently, i.e. without human intervention. A decisive basis for this are the so-called **cyber-physical systems** (CPS). They connect information and mechanical components via software. The data exchange (incl. control) takes place via a network (usually the Internet) in

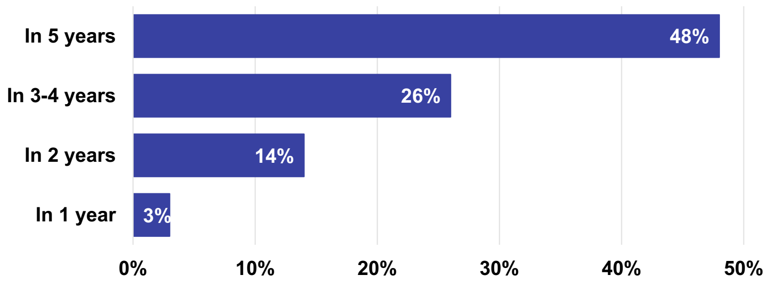

Fig. 3.4 ROI of the investment in digital factories and digital concepts. *Source* Adapted from PWC (2017, p. 16)

real-time. The following **components** are usually contained by cyber-physical systems (cf. Bendel, 2019):

- **Systems** (e.g. for procurement, production, logistics, communication) and **connected objects and processes** (components of the Internet of Everything) for controlling and monitoring processes; if necessary, use of cloud services and Edge-AI
- **Sensors** and **wireless communication technologies** (such as Bluetooth or RFID) for registering and processing data from the physical world
- **Stationary and mobile equipment, devices and machines** (e.g. robots)
- **Actuators** (e.g. drive elements) that act on the physical world (e.g. in the control of production processes or as impulses for robots)
- **Technologies for the evaluation of big data**, since very large amounts of data are often generated in real-time, e.g. to support quality control
- **Cyber security modules** (to protect processes against internal and/or external cyber-attacks)

In the networks mentioned above, two characteristics are to be differentiated. **Internal networking** links the internal components of the production process at one location. **External networking** includes (independent) communication with other smart factories. This allows—AI-supported—learning from the successes and failures of other factories across production sites—ideally even in real-time.

Memory Box
Cyber-physical systems are the precondition for communication between real and virtual components. Consequently, they form the interface between hardware and intelligence in a **smart factory**.

The future of such systems is caused by the fact that not only the systems exchange information with each other. The **workpieces** and the **materials** required for their completion can also **communicate independently** with each other and with the production systems. A supplier part or a product in the manufacturing

process can show the data required for further processing in machine-readable form (e.g. on an RFID chip or as a QR code). On the basis of this information, the further production steps are triggered independently. This enables a high degree of flexibility in production to be achieved if the production systems are designed accordingly.

These developments are accompanied by a further form of **visibility**. Previously, it was only possible to determine at **batch level** where this was produced when and by whom in many production processes. In the future, such an assignment will be possible at **unity level**.

General Electric has set up such a smart factory for **the production of batteries**. More than 10,000 sensors record temperature, humidity, air pressure and machine data in real-time. At the same time, all material flows are recorded at unit level. The production processes are also monitored at unit level. Necessary adjustments, which are identified by the AI application, can be made in real-time. Thus, the performance of the batteries in each individual case can be traced back to the specific conditions at the time of production (cf. O'Marah & Manenti, 2015, p. 3).

Siemens has also built a "digital factory" with the *Amberg* electronics plant. Here, twelve million **programmable logic controllers** (PLCs) are produced annually in more than 1,000 variants for controlling machines and systems. The products control their production themselves. For this purpose, they inform the machines via a product code which requirements they have, and which production steps are required next. Today, the degree of automation in the value chain is 75%—in the future the factories will control and optimize themselves to a large extent. The quality quota is a staggering 99.99885%. In addition, all workstations—even those that are not automated—are supported by data technology (cf. Hochreiter, 2016).

The US company *Cisco* is using a **virtual manufacturing execution system platform** (VMES). This enables real-time visibility of the processes within the global production network. Through the use of cloud computing, big data analysis and Internet of Things, the information of all production facilities is connected with each other. In this way, global production processes and material flows can be coordinated with each other. In addition, a forward-looking quality assurance is possible. Each object is given a "digital identity" so that it can be located at anytime and anywhere—along the entire supply chain (cf. O'Marah & Manenti, 2015, p. 4).

The mechanical engineering company *Trumpf* has set up a smart factory in Chicago to demonstrate the effects of fully connected production to interested parties. The 15 machines used are controlled by two persons from one control station. The data supplied by the aggregates are continuously used to (independently) optimize the processes. Predictive maintenance functions are also integrated. In the future, additional services will be offered via software that can be activated as required. A *Trumpf*-owned startup has developed the *Axoom* platform to connect the various machines and processes. Here, machines and apps from third-party partners can also be integrated (cf. Mahler, 2018, p. 76f.).

Such connected and intelligent factories create the possibility for **highly individualized production**. Through an intelligent connectivity of the production plants with a high degree of self-organization of the plants, production processes can be designed much more individually and thus flexibly. This makes it technically and economically possible to produce small batches and single pieces. Here we can speak of **mass customization**—a mass production of individual pieces, which used to be a contradiction in terms. The intelligence of the production plant makes it possible to combine customer-specific solutions with the advantages of process-optimized mass production. For this purpose, the customer can assemble the desired product from a **modular system**. Based on the respective customer requirements, the manufacturing processes are independently optimized on the basis of time and cost targets.

If such **production systems are connected to a customer interface**, they can change their preferences just before the start of production—or even while the production process is still running. How quickly such changes can still be made depends on the duration of the necessary procurement processes and the set-up times of the equipment used. The customer receives here—within limits—a quite extensive intervention in the production. This will meet the expectations of the customers; after all, in other fields they also have the feeling of acting even more comprehensively in real-time—thanks to *WhatsApp* as well as through many streaming offers! At the same time, a new form of customer experience becomes possible.

In the *Augsburg model factory* of the robot manufacturer *Kuka*, very flexible production is made possible by the use of **Automated Guided Vehicles** (AGVs). These vehicles collect the tools required for production from a tool store and take them to the production sites to be converted. In addition, they control a central material store, which is decoupled from production, in order to pick up the components required for further production there and also bring them to the production facilities. The necessary control can only be achieved with AI algorithms. At the same time, AI systems can fully exploit their advantages: programming effort is reduced, operation is simplified, and processes are very flexible. This allows to break up rigid production chains that no longer meet the requirements of the market due to small batch sizes, high fluctuations in orders and/or an increasing variety of products. In the *Smart Production Center* in a model factory, *Kuka* shows what a flexible matrix production can look like, in which different products can be individually manufactured on one system (cf. n.a. 2018).

Memory Box
Smart production is less about the "what" of production than about the "how"! A correspondingly "product-neutral" production consists of several flexible and robot-based production units. This is called a **matrix production**. The heart of the system is an AI application that optimizes the entire process taking into account the respective cycle and delivery times according to pre-defined parameters.

3.4 Further Development of the Value Chains and the Value Systems

It becomes clear that these development steps will bring about a dramatic **change in the classic value chain**. This must be penetrated through a **digital (information) value chain** in order to achieve the effects described above (cf. Fig. 3.5).

The digital value chain can make a decisive contribution to overcoming corporate data silos through its comprehensive connectivity of various service areas. Instead, a **data and process ecosystem** must be set up. In addition to the consolidation of internal information streams, an outside-in process must be used to integrate further information from the business environment and in particular from suppliers and customers. This connectivity makes it possible to react much faster and more comprehensively to necessary changes, as the examples described above show. The **digital value chain** is thus virtually an **informational supply chain**—for connecting internal and external information streams.

Memory Box
Companies are challenged to build **end-to-end data solutions instead of data silos**. This not only enables us to achieve efficiency and effectiveness targets in production, but also to generate additional customer value. On top of that, new business models can be developed.

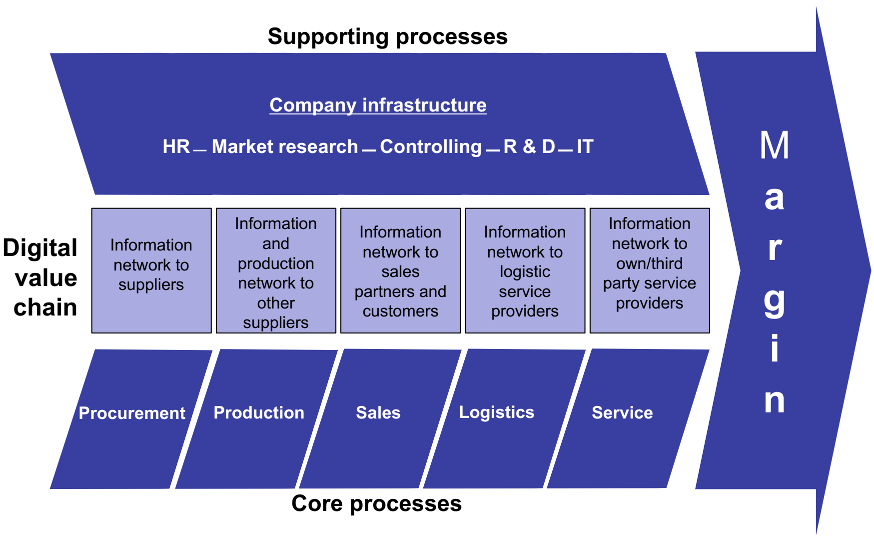

Fig. 3.5 Physical and digital value chains. *Source* Kreutzer, Neugebauer, and Pattloch (2018, p. 23)

In case that not only own value chains are interconnected, but also the value chains of other upstream and downstream companies are interlinked, **systems of integrated value chains** (also **value systems**) are created (cf. Fig. 3.6). On the input side, the company's own value chain is linked to the value chain of direct and indirect suppliers. On the output side, there is a connection with the value chain of direct and indirect customers. This form of network is not only relevant in the B2B sector but can also involve consumers (e.g. by connecting with a smart home or a smart fridge). Through this information connectivity, additional efficiency and effectiveness reserves of value creation can be exploited—both on the supplier and on the customer side. Again, the core for new business models can be seen here.

The **evaluation and optimization of such complex and widely connected data and process flows** cannot be managed without comprehensive AI systems. The classical programming required for this would go beyond the limits of feasibility in terms of time, complexity and costs.

Memory Box
If you want to survive in the digital world as a manufacturer in the long term, it is not enough to just digitalizing your own production processes. The manufacturers themselves or networks of manufacturers are in demand to develop **high-performance platforms** in order to achieve the network effects shown.

Otherwise there is a danger that **platforms of the established digital corporations** will be pushed between our company and our customers—and that direct customer contact will be lost. Then our company is degraded to an exchangeable service partner "without a face" towards the customer, as is already the case in many consumer-oriented applications. Platforms such as *Airbnb, Amazon Marketplace, Holiday Check, Trip Advisor* and many others have placed themselves between suppliers and customers. Now these platforms dominate the customer interface—and vendors have to pay for customer access!

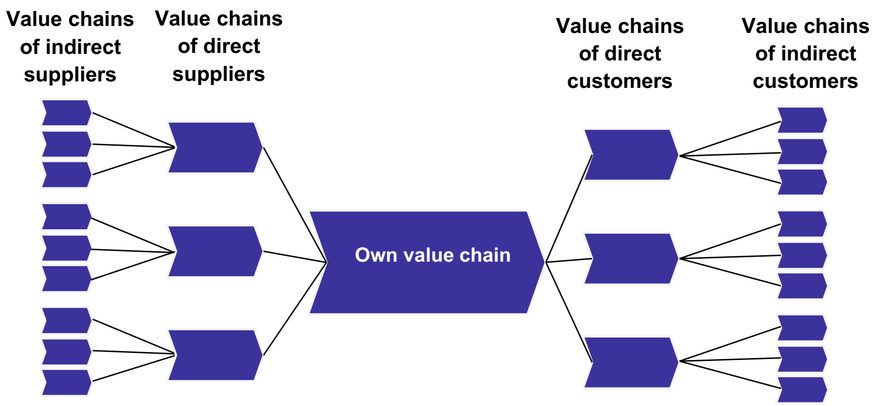

Fig. 3.6 Additional competitive advantages based on a value system. Kreutzer et al. (2018, p. 25)

3.5 Effects of Smart Manufacturing and Outlook

The **effects of smart manufacturing** are summarized in Fig. 3.7. The results shown there are based on a worldwide survey of 418 Chief Manufacturing Officers. Again, we don't need to put every number on the gold scale; it is about the dimensions of the improvements that smart manufacturing can bring!

In summary, the **advantages of an AI-based smart factory** can be described as follows:

- Continuous, independent optimization of production processes on the basis of time and cost specifications
- High flexibility in production; reduction of time-to-market if necessary (e.g. for innovations or changed product requirements)
- Increase in productivity through automation and reduction of employee deployment
- Reduction of warehousing costs through automated ordering processes as well as through a consumption-based supply of components and raw materials and through optimized delivery processes of the finished products.
- Production of single pieces and small batches at the cost of mass production
- Real-time visibility of the supply chain, production and/or delivery to customers

The **disadvantages of an AI-based smart factory** must not be overlooked:

- High to highest process complexity due to the intensive connectivity of different components and data, a multitude of interfaces, different software solutions with possibly diverging update rhythms
- Dependence on a few specialists who (still) are able to master the new complexity

Key manufacturing metrics	Reading today	Expected reading with smart manufacturing	% improvement
Quality (% defect rate)	4.9%	2.5%	-48.9%
Unplanned downtime (% on total uptime)	11%	5.8%	-47.8%
Annual energy cost (approximate US-$/plant)	$ 8,415,318	$ 6,939,560	-17.5%
Inventory turns (number of times your inventory cycles or turns over per year)	14	19	34.8%
NPI (new product introduction cycle time (average number of months taken to introduce a new product into the market)	15	11	-23.1%
Overall equipment effectiveness	**73.6%**	**85.5%**	**16.2%**

Fig. 3.7 Effects of smart manufacturing. *Source* Adapted from O'Marah and Manenti (2015, p. 6)

- "Confidence" in the quality of AI-based solutions (even autonomous systems can make wrong decisions, follow inappropriate rules or interpret data incorrectly)
- Susceptibility to faults with high internal and external dependencies
- Risk of cyber-attacks due to communication over the Internet
- Reduction of jobs of less qualified employees (also an advantage, depending on the respective perspective)

Memory Box
Even though many processes in a smart factory are self-organizing and thus a high degree of automation is given, the employees are of great importance with regard to **planning, control and optimization of corresponding cyber-physical systems**. Although these processes are also supported in terms of AI, they are not yet carried out independently. The development of a smart factory must therefore be preceded by the development of own suitably qualified employees!

Further dramatic changes are associated with the **increasing use of robots in production** (for the different robot types, cf. Sect. 1.3.4). A large growth field is seen in the so-called **collaborative robots** (cobots), which can work hand in hand with people and no longer need fenced workplaces. **Self-programming robots** can —based on AI-technologies—develop their performance independently—in each case based on the gained experiences. **Autonomous robots** automatically download the programs required for production from a cloud library. If these are designed as self-programming robots, these programs can be independently optimized through "self-learning". Robots that perform the same tasks globally can compare and optimize their performance at the touch of a button or automatically. This enables **automated benchmarking with an automatic implementation of optimizations**—across time, language, culture and country boundaries (cf. IFR, 2017, p. 24).

Bosch uses such a **self-learning system** at its eleven locations worldwide to manufacture brake control systems. If one welding station in India works better than all the others, this is automatically visualized to the other locations in the worldwide network, so that appropriate adjustments can also be made there. According to *Bosch*, the connectivity of machines and factories enabled double productivity within five years (cf. Walter, 2018, p. 55).

Figure 3.8 shows the extent to which **industrial robots** are or will be used. Again, it becomes clear where the competition for Germany and the USA lies—in Asia!

Figure 3.9 shows which countries dominate the use of robots.

Food for Thought
In Asia and above all in China, the use of Artificial Intelligence and industrial robots is being driven most strongly. In the future, China will not challenge Europe and the USA with low-cost products but with intelligent systems—and on a gigantic scale!

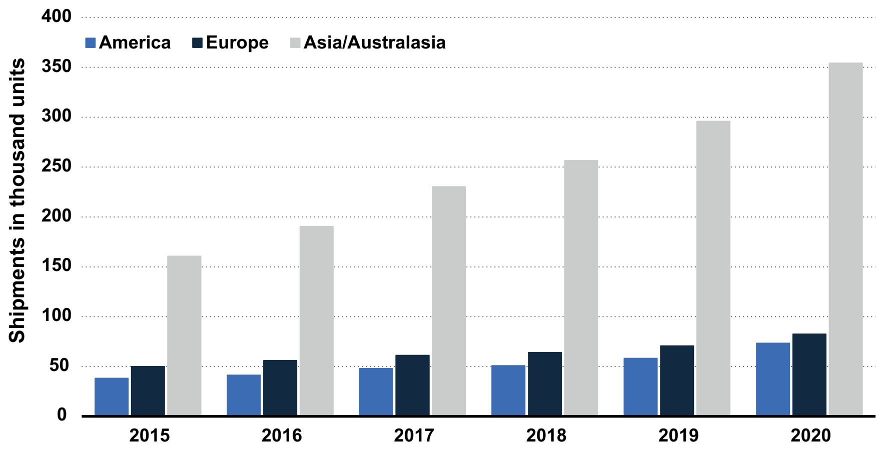

Fig. 3.8 Estimated annual deliveries of industrial robots in selected regions worldwide from 2015 to 2020—by region (in 1,000 units). *Source* According to IFR (2017, p. 16)

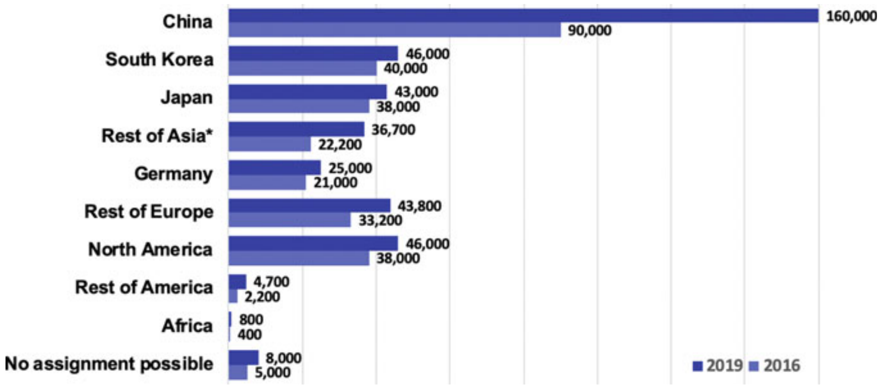

Fig. 3.9 Estimated worldwide sales of multi-purpose industrial robots (* incl. Australia). *Source* According to IFR (2018)

What effects could be achieved through the use of **collaborative robots** (**cobots**) or **context-aware robots** (cf. McKinsey, 2017, pp. 8, 26)? First of all, “hand-in-hand” work between humans and robots becomes possible because they react independently to changes in the working environment. This allows the dissolution of the fenced “robot work areas” that previously had to protect people from robots and caused high costs. An important contribution to this is made by AI-based image recognition (cf. Sect. 1.3.2). This makes efficiency-enhancing collaboration between humans and robots possible, even for tasks that cannot be fully automated. An increase in productivity of up to 20% has already been achieved for various tasks.

To achieve these targets a human being can train the robot. Then the robot is able not only to repeat the learnt steps—but to improve them on a constant basis. After the training session a natural cooperation between robot and men is possible. This cooperation is fed by data collected by sensors and cameras (cf. McKinsey, 2017, p. 27).

Artificial Intelligence also makes it possible **to exploit the potential for revenue growth**. This is achieved by evaluating machine data in real-time. Relevant insights for optimization are gained by the linked evaluation of thousands of variables across different machines, process stages and production sites. First, an AI-supported root cause analysis enables quick decisions on optimization measures. Then data streams from the production process feed the AI engine to derive process optimizations. In addition AI-supported analyses of processes and designs indicate "yield killers". The following effects can be achieved by the measures described above (cf. McKinsey, 2017, p. 8f., 29):

- Reduction of test costs
- Reduction of error/scrap rates through AI error identification
- Reduction of production-related lower yields by up to 30%
- Automation rates of up to 30% are possible

In addition, **automated quality control** can be achieved through Artificial Intelligence. For this purpose, the visual intelligence described in Sect. 1.3.2 is used for quality control. An automated visual check is carried out during the production process to determine any errors. This allows productivity increases of up to 50% to be achieved. The increase in the error detection rate by up to 90% compared to human error detection makes a decisive contribution to this. To achieve these results a variety of cameras take photos to feed the AI engine with quality control data. The AI engine processes thousands of images to detect errors. Employees are automatically notified of errors—instead of having to search for them first themselves (cf. McKinsey, 2017, p. 9, 31).

Artificial Intelligence can also contribute to the **optimization of business processes**. Thus, supply chains can be optimized by increasing the forecast quality of demand and thus improving inventory management (in terms of volume and objects). This allows the following effects to be achieved (cf. McKinsey, 2017, p. 9):

- Prediction errors are reduced by 20–50%
- Loss of turnover due to lack of ability to deliver is reduced by up to 65%
- Stock can be reduced by 20–50%

In order to fulfill these expectations AI combines internal and external data to predict demand. Optimized forecasts enable lower inventory levels along the entire value chain. Routes and quantities of material flow are optimized based on real-time data (cf. McKinsey, 2017, p. 33):

Finally, Artificial Intelligence can also contribute to a **significant increase of R&D success**. To this end, machine learning is used in research and development to improve target-oriented communication within and between R&D teams. The following effects can be achieved here (cf. McKinsey, 2017, p. 9, 35):

- Reduction of R&D costs by 10–15%
- Reduction of time-to-market by up to 10%
- Reducing the flop rate of R&D projects

Another exciting field of application is the **AI-controlled optimization of logistics processes**. AI algorithms can optimize the following areas in the logistics chains and thus contribute to efficiency increase and cost reduction:

- The **optimization of the delivery processes** themselves can reduce energy and storage costs and at the same time shorten delivery times and increase delivery reliability.
- Sensors make it possible to **monitor the performance of integrated means of transport** (such as cars, trucks, aircrafts, drones). This enables energy consumption to be optimized. In addition, predictive maintenance can avoid downtimes and in turn shorten delivery times and increase delivery reliability.
- Special sensors are used to **monitor vehicle drivers** and enable real-time coaching. While dynamic congestion avoidance is already standard today, further developed systems can help to optimize driving style and prevent accidents. In addition, impulses can be given as to when—in addition to the legal requirements—rest periods are announced. For this purpose, continuous monitoring of the driver's gestures and facial expressions through image recognition can provide important impulses.

McKinsey (2018, p. 21) has determined which **overall effects in supply chain management and production** can be achieved through the use of Artificial Intelligence in the coming years. More than 400 AI-related use cases in different companies were analysed for this purpose. The following figures give an idea of the additional added value that can be achieved in various areas:

- **Predictive maintenance**: US-$500–700 billion
- **Yield Optimization**: US-$300–600 billion
- **Procurement management**: US-$100–200 billion
- **Stock management/parts management**: US-$200–300 billion
- **Forecasts for sales and demand**: US-$100 billion

These numbers give an idea of what can be achieved by Artificial Intelligence in the individual functional areas. After marketing and sales, these are the highest value creation potentials determined in the course of this analysis. They should motivate you to go on the AI journey for your enterprise (cf. Sect. 10.3).

The developments described above support a process that can be described as **reshoring**. In contrast to offshoring, this means the **relocation of production processes from abroad** back to high-wage countries like Germany or the USA. *Gigaset Communications* is already producing a mobile phone again in Germany. The world market leader for pumps, *Wilo*, has chosen Dortmund in Germany as the location for its smart factory. Also *Adidas* produces for the first time again in larger style shoes in Germany with their *Speed factory*. Individually adapted shoes are produced with 3D printers—each one unique. *Bosch* builds a new chip manufacturing plant in Dresden, Germany. The *Bosch* subsidiary *BSH-Hausgeräte* is also expanding its production capacities in Germany—to supply refrigerators to China from here! Reshoring is even being considered in the clothing industry—because in many cases the low-wage countries have already exhausted their cost-cutting potential to a large extent (cf. Jung, 2018, p. 61; Fjellströ, Lui, & Caceres, 2017). The *A.T. Kearney's* **Reshoring Index** shows, that US-manufacturers are not coming back in droves. In fact, the 2018 Reshoring Index shows that imports from traditional offshoring countries are at a record high (cf. Abraham, Levering, Bossche, & Gott, 2019).

Memory Box

The idea of the reshoring is to bring manufacturing jobs back to high-wage countries. This decision has to be based on an accurate calculation of the total cost of offshoring.

What makes such reshoring steps possible? In smart factories, personnel costs only account for a very small proportion of manufacturing costs. Often it is less than 5%. This makes it easier to bring production back to high-wage countries, which usually have a good hard and soft infrastructure (logistics, training, legal system, etc.). The developments surrounding smart factories could lead to a reduction in the **dynamics of the global exchange of goods** and a **strengthening of production closer to the target markets**.

According to a survey of 1,300 companies in Germany, the **arguments for reshoring** are as follows (cf. Frauenhofer, 2015):

- 56%: flexibility
- 52%: quality
- 33%: capacity utilization
- 31%: transportation costs
- 15%: infrastructure
- 11%: personnel costs
- 5%: proximity to domestic research and development

The following applies: more robots in an industrialized country leads to fewer offshoring and more reshoring. It is therefore understandable that this reshoring will not lead to a job boom. Many manual production steps that led to offshoring years and decades ago will in future be taken over by robots (cf. Jung, 2018, pp. 61, 62).

Memory Box
Production companies are already generating comprehensive data streams in many areas. This is not the bottleneck. However, we have an implementation problem—from possibilities and potentials to concrete action. This is where the future focus must be directed!

Summary

- Artificial Intelligence can unfold its **comprehensive effects** especially in the field of production.
- In addition to **cost reduction** through more efficient use of plants and processes, **flexibility in production** can also be increased.
- Through a **digital value chain**, the necessary connections to upstream and downstream service partners are achieved.
- The **development of a system of value chains** can contribute to increasing the switching costs of business partners and at the same time provide impulses for new business models.
- The use of AI can achieve **significant improvements in the relevant KPIs** across all stages of the value chain.

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4 Fields of Application of Artificial Intelligence—Customer Service, Marketing and Sales

Abstract

In this chapter you will see how Artificial Intelligence can support lead prediction and lead profiling to identify look-alike audiences. The possibilities to develop individualized recommendations and media plans based on AI will be discussed, too. A relevant use case of Artificial Intelligence is conversational commerce—leading from voice first to voice only. We can use AI systems for sentiment analyses and for content creation and content distribution, too. The detection of fake accounts and fake news poses a great challenge for AI processes.

4.1 Service Sector: From Simple Chatbots to Digital Personal Assistants

4.1.1 Expectation Matrix of Customers and Companies

AI-based applications can be used in many different ways in the service sector. The industrialized and emerging countries are developing more and more in the direction of a **service economy**, which is accompanied by major challenges for Artificial Intelligence. Before illuminating where Artificial Intelligence can optimize service delivery, it is necessary to take a look at the expectations of customers and companies. The **expectation matrix of customers and companies** is the ideal tool for this purpose. The analysis, which was originally focused on dialogs, is now more broadly focused on customer-oriented processes. This enables you to systematically determine the extent to which such processes contribute to fulfill your company and/or customer expectations (cf. Fig. 4.1).

In the field of **eliminate**, the expectations of companies and customers go in the same direction (cf. Fig. 4.1). Such processes and discussions only lead to costs and

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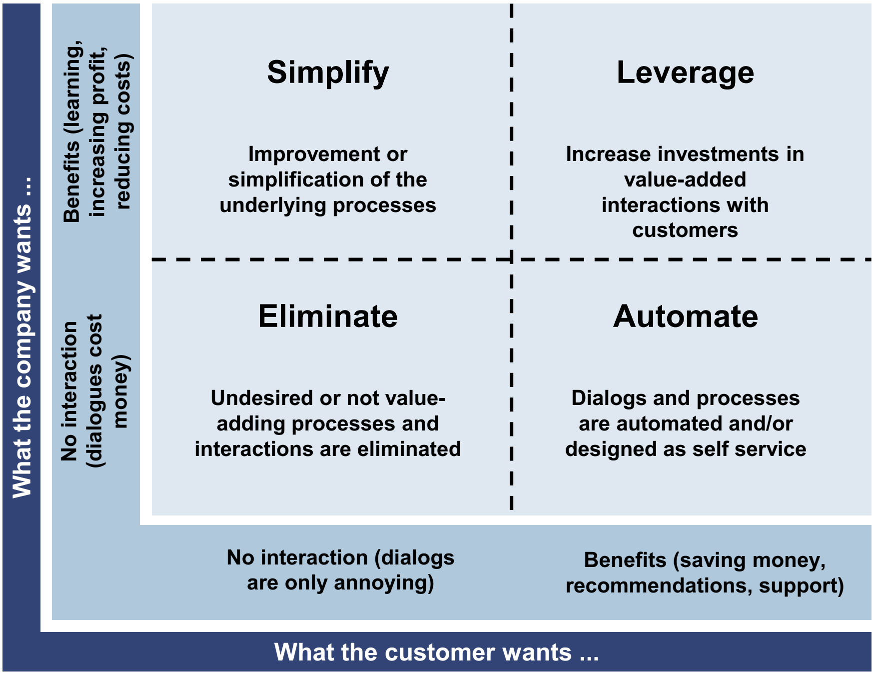

Fig. 4.1 Expectation matrix of customers and companies. *Source* Adapted from Price and Jaffe (2008)

are not desired by customers. They can be deleted from the scope of services. At **automate**, the expectations of companies and customers diverge: while the company would like to avoid such processes, customers want and expect them in the form of consulting, support, etc. In order to find a balance of interest here, you can rely on automation (e.g. via chatbots) or on self-service offers. This means that constantly repeating questions can be answered cost-effectively. In addition, AI-supported personal recommendations can be provided.

With **simplify** the interests also fall apart and lead to a divergence of expectations. While the company sees value-adding opportunities here (e.g. by obtaining e-mail permissions or by the implementation of check-in procedures, follow-up calls, requests for evaluation), the customer is annoyed in the worst-case scenario! Simplification and improvement of processes are necessary here (cf. Fig. 4.1). In the **leverage** field, there is a correspondence of expectations. Here it is necessary to invest in the underlying processes in order to exploit the existing potential. Value-creating dialogs can be achieved by presenting the call agent—in real-time—with optimal next-best offers as well as other recommendations that have been identified with AI support as relevant for the customer. This can sustainably improve customer experience. Leverage can also involve the joint development of solutions that can lead to an increase in customer loyalty.

Memory Box
The **expectation matrix of customers and companies** provides you with an important orientation framework to set the right priorities for automation through Artificial Intelligence—and to keep customer expectations in mind!

4.1.2 Voice Analytics and Chatbots in the Service Sector

Customer service offers an exciting field of application for Artificial Intelligence. Here, AI applications can unfold their disruptive power and replace many traditional solutions and processes. In this way, the digitalization of the customer journey can be driven forward by Artificial Intelligence. Thereby, **different development stages** can be distinguished. These range from **voice identification** and **voice analytics** to AI-supported communication via a simple **chatbot** and **digital personal assistants**, which—like smartphones today—are becoming indispensable managers of many everyday tasks. The trend is towards **automated customer service**.

AI applications, based on comprehensive customer databases, can help to **improve customer experience** by providing service center agents with relevant customer data and information about customized offers to support value-added communication. This can improve the quality of the service center contact.

Voice identification (**speech recognition**) distinguishes between two fields of application. On the one hand, it includes the **processing of natural language** already mentioned in Sect. 1.3.1 (NLP; core task "What is said?"). On the other hand, it is about the **speaker recognition** ("Who speaks?"). The focus is on the identification of a person on the basis of the characteristics of a voice. The process also known as **speaker verification** or **speaker authentication** is of great importance for the identification of customers when security-relevant processes or important transactions (e.g. telephone banking) are controlled via voice. Speaker recognition is also important for simple orders via voice—for example via a digital personal assistant.

Food for Thought
Had such speaker recognition been present at *Alexa*, the following example would never have existed. It started out harmless: A girl in the USA had ordered a doll's house and kilograms of biscuits from *Alexa*. It had quickly learned how mum and dad used *Alexa* as a shopping assistant. An avalanche started when a newsreader in an US news broadcast reported about this case and said the fateful sentence: "I love this little girl, as she says, '*Alexa* ordered me a doll house'" (Kaltschmidt, 2017).

Since *Alexa* is installed in many US households near the (often continuously running) TV set, many *Alexa* devices heard this command—and executed it! A large number of complaints were received by the station because *Alexa* had triggered purchase processes here—only apparently unsolicited. Because *Alexa* had heard—almost correctly—from the sentence "*Alexa* ordered me a doll house" the activation command "*Alexa*" and perceived the command "doll house ordered". The fact that *Alexa*—at the moment—does not yet master the subtleties of the individual

tempos is forgiven. It can be assumed that millions of users do not master these tempos either!

To prevent such effects, *Alexa*-internal solutions exist: The purchase option is enabled by default on *Amazon Echo* but can also be turned off. Alternatively, a PIN can be stored to confirm each purchase. The security guidelines do exist, but who has always used them consistently?

Food for Thought

Let's go on another journey of thought. A truck with big speaker boxes drives through a street. Out of these boxes, the command "*Alexa*, open the door" repeatedly booms. What will happen when *Alexa* becomes a family member in more and more households?

To enable speaker recognition for orders, but especially for door-opening commands so-called **voice prints** can be created. The corresponding systems take advantage of the phenomenon that each voice is unique. The causes of distinguishable acoustic patterns are due to anatomy (e.g. size and shape of neck and mouth) as well as acquired behavioral patterns (e.g. vocal pitch and articulation, often connected by dialects). These features are represented by a **sound spectrogram**. The spectrogram represents the frequency of a sound on the vertical axis over time on the horizontal axis. This is the core of the voice print—and much more elegant than an iris scanner, which we usually encounter in agent films—and works with eyes that are no longer in their natural place!

Speaker recognition usually takes place in two phases: registration and verification. During the registration phase, the voice of the speaker is recorded to create the voice print. In the verification phase, the new voice print is compared with an earlier recorded voice print. It is up to our imagination to guess how such a voice print works after a visit to the dentist (with anesthetic) or in case of an acute cold!

It would be exciting to find out if the following use of *Alexa* could have been avoided by speaker recognition. What happened? The parrot *Rocco* from *Blewbury*, England, caused a sensation: He ordered various things on *Amazon* through *Alexa* by imitating the voice of his owner. *Rocco* is a grey parrot who possesses the intelligence of a five-year-old child. This parrot species can repeat and repeat words almost true to the original. So *Rocco* quickly realized how to operate *Alexa*. After activation, the parrot ordered broccoli, raisins, watermelons, ice cream and even light bulbs and a kite. *Rocco* also put on *Alexa* for musical entertainment and wanted music to which the parrot then danced (cf. Hesterberg, 2018).

As users, we should therefore think about various mechanisms that help to ward off such misuse and attacks through so-called social engineering. **Social engineering** is the term used to describe an interpersonal influence that takes place with the aim of triggering certain behavior patterns in the other person. This can be the communication of confidential information (e.g. passwords) or the inducement to transactions harmful to the person concerned (e.g. purchases or transfers). The so-called **social engineers** spy on the personal environment of the victim in order to then pretend to people from this area that one is person X or Y (keyword "grandchild trick"). Social engineers—based on stolen information—often also

penetrate external IT systems. It is the so-called **social hacking**. This can be prevented or at least made more difficult if powerful speaker recognition is used. But we have to keep in mind that today people often falsify speech patterns—e.g. in videos (cf. Sect. 8.2).

Memory Box
If we want to implement digital personal assistants as the interface in our customer communications, we need to integrate speaker recognition to prevent misuse of the interface. "Speech recognition" without "speaker recognition" alone is no longer sufficient.

What's next? **Voice recognition becomes the new face recognition!**

Voice analytics can also be used to learn more about the speaker. The tonality of the speaker can be analysed in order to deduce the emotional situation and thus also the urgency of the concern ("How is something said?"). In the case of critical interlocutors who are determined by voice analysis in a call center, the call can be routed to particularly qualified employees. The German-based company *Precire Technologies* has developed an advanced **AI system for voice analytics** that can measure 42 dimensions of a personality (cf. Precire, 2019). At *Talanx Service*, an insurance company, this system is used in addition to other methods in the selection of personnel for the board of management and the following management levels. It is also used in top management for the further development of the company's own employees. How is it done? The *Precire* program analyses how people speak—quietly or quickly, with or without pauses, emphasized or rather unemphasized, etc. (cf. Rövekamp, 2018).

For this, the participants should tell the program about a project, the last holiday or something about a certain day. It is less relevant what is said, but how it is said. This involves recording which words are used, how fast they are spoken and how they are pronounced. This conversation should last 10–15 min. Based on these raw data, the *Precire* algorithm measures 42 dimensions of a personality. It is about resilience (in the sense of mental resistance), optimism, curiosity and influence. At *Talanx Service* these test results supplement the applicant's overall picture—i.e. the CV and other impressions gained in personal interviews and/or an assessment center (cf. Rövekamp, 2018).

For the development of its own team, the company *Precire* develops **tailor-made training proposals** that can be called up in the form of practice units via a learning platform. *Precire CommPass* identifies personal resources and fields of development. The communicative effect can be improved by suggestions based on this. A distinction is made here between the expected profiles of sales, service and management. In one example, the following modes of action for a sales profile could be discovered with the help of Precire (2019):

- 70% goal-oriented
- 70% responsible

- 69% supportive
- 69% capitalizing
- 61% emotionally open
- 55% informative
- 53% balanced
- 43% cautious

The *Precire* algorithm is also used for the **analysis of customer conversations**. The language can be analysed in order to identify emotions, personality and language competence of the dialog partners. Motives and settings that would otherwise have remained hidden can be made visible. Ideally, it is possible to dispense with a follow-up survey of the customer after a telephone conversation because the voice analysis already shows that the customer was satisfied with the dialog result (cf. Precire, 2019).

An **AI-based measurement of customer satisfaction** is an ideal supplement to the widely used **Net Promoter Score** (**NPS**). It is a powerful and equally easy to use concept to capture the extent of emotional attachment and trust customers have in your business. In essence, the NPS is determined by the simple question of how many percent of one's own customers would continue to recommend one's own company (net). The basic concept of the NPS is described in Fig. 4.2.

In order to determine the **Net Promoter Score**, a single question is asked: "How likely would you recommend this company, this service, this product, this brand to a friend or colleague? The answers can be given on a scale from "0" ("not likely at all") to "10" ("very likely").

Promoters (fans) of a company or a brand are only those who assign the value "9" or "10". **Detractors** (critics) are those who only assign values between "0" and

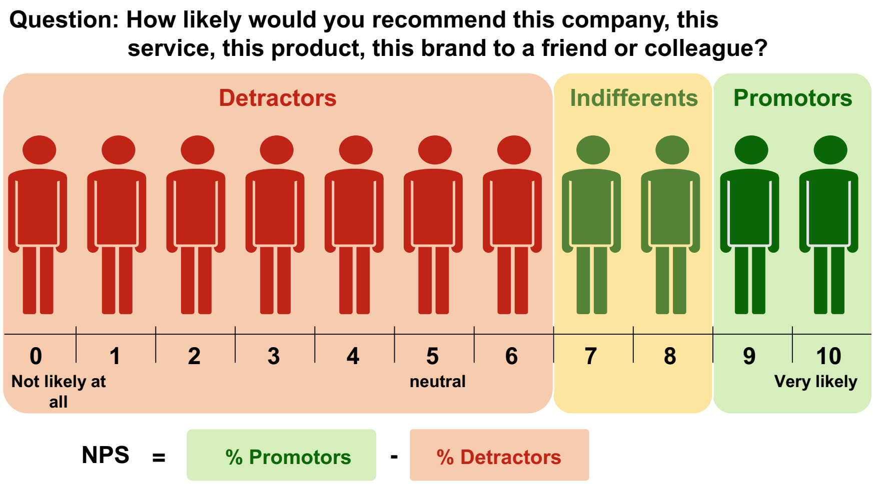

Fig. 4.2 Basic concept of the Net Promoter Score (Authors' own figure)

"6". **Indifferents (passive)** are those who assign the value "7" or "8". When calculating the net value of the recommendations, the percentage of detractors is subtracted from the percentage of promoters. The group of indifferents is not taken into account. Consequently, the calculation formula of the NPS is as follows:

$$\text{NPS} = \text{promoters (in \%)} - \text{detractors (in \%)}$$

In the best case, the **values of the NPS** can be "100%" if all customers have assigned the value "9" or "10". In the worst case, the result is "−100%" if all customers have only assigned values between "0" and "6" (cf. Reichheld, 2003). It is ideal if your customers have to justify their decision in the free text field after the points have been awarded. Through the comments, you gain important additional information in order to identify purchase drivers as well as reasons for migration and to derive actions from them.

Memory Box
The **Net Promoter Score** is an easy and quick to install instrument for you to determine the confidence—measured by the degree of readiness for recommendation. In this way, the AI-based measurement of customer satisfaction can be optimally supplemented. By using an AI-supported text analysis you can additionally evaluate the many 100, 1000 or 10,000 free text comments.

Chatbots already play a particularly important role in customer service (cf. also Sect. 1.3.1). These have undergone rapid development in recent years. At the beginning there was a pure **text-based communication interface** (TTT). Here the user had to type in his question etc. in a text input field—and the answer was also presented in text form in the text output field. Meanwhile, many chatbots have evolved into a **completely conversational interface** that supports dialog in spoken language. No screen, keyboard, or mouse is required. The input and output takes place via spoken dialogs.

If you summarize the current and future **tasks of text-based chatbots** (TTT), the following picture results:

- **Chatbots to optimize customer-initiated communication**
  This type of chatbot helps users to solve every day online tasks more efficiently. This allows problems to be solved without having to click through FAQs for a long time. In addition, legal advice, a new fashion outfit, a trip at a reasonable price or a simple recipe for fried eggs can be found quickly and without detours via dozens of websites.

  Mantra: Find, not search!
  The legal **advice expert system** *Ailira* from Australia provides its clients with corresponding information. The system uses Artificial Intelligence to provide free information on a wide range of legal issues, triggered by natural language processing. These include topics such as corporate restructuring, wills and estate

planning. In addition, this application offers the possibility to create legal documents for business and private use in Australia. The ***Ailira* Messenger Chatbot** 24/7 is available for this purpose. *Ailira* can also be reached via the *Facebook Messenger* (cf. Ailira, 2019).

The personal **fashion shopping assistant** *Emma* helps the interested user to find the right products (cf. ChatShopper, 2019). **Travel advice** is provided by chatbots such as the *SnapTravel* bot. This makes it possible to find and book the best hotel offers via *Facebook Messenger* and SMS. Starting with a chat, the AI-based bot searches hundreds of sources to find the best hotel deals. This chatbot is supported by a team of employees who can also be reached via chat. In addition, *SnapTravel* promises to call the booked hotel on the check-in day to negotiate a free upgrade (cf. Snaptravel, 2019).

Kayak (2019) also enables such a travel search via the *Facebook Messenger*. This chatbot helps you to search, plan, book and manage trips. In addition to the specified travel budget, the corresponding selection also takes into account a pre-selection of possible destinations in connection with the best travel period. The entire planning process, the booking and the provision of further information about the travel process are also transmitted via messenger.

Another interesting example is the *1-800-Flowers* chatbot based on *IBM Watson*. In the opening dialog, users are first asked whether they want to place an order or talk to someone. The chatbot also asks for a delivery address in order to find out whether delivery can be made there. This is followed by the selection of the desired product (cf. 1-800-flowers, 2019).

- **Chatbots for proactive (individualized) communication**

  Such chatbots have the task of becoming active within predefined use cases. It is important to pass on relevant information to users at the right time. The impulses for this are often based on marketing automation concepts. AI algorithms can be used to define the relevant triggers. Such triggers can e.g. include a "comeback trigger" for customers after two months of order abstinence. Even after a complaint has been processed, a friendly follow-up can be carried out to determine whether a satisfactory solution has been reached. Chatbots can also be used to support further qualification of leads. For this purpose—based on the already available data—corresponding questions are generated AI-supported.

  A further example of a proactive chat application is the *KLM Messenger*. The airline *KLM* uses this to provide flight documents via messenger. After booking a flight on *KLM.com*, passengers can choose to receive their booking confirmation, check-in notification, boarding pass and flight status updates via messenger. Further questions can also be answered directly via the messenger (cf. KLM, 2019). This proactive provision of information is associated with the advantage that customer-initiated (cost-intensive) communication approaches can be reduced for the company.

- **Chatbots for proactive (general) communication**

  Other chatbots also proactively provide information that is not played out individually. This includes *Novi*, a messenger service of the content network of the

German TV-channels *ARD* and *ZDF* (cf. Novi, 2019). Here, similar information can be sent either to all customer segments or to specific customer segments.

What does the **performance of chatbots** look like **in complex communication**? The risk associated with a company letting a chatbot learn and act freely itself is illustrated by *Microsoft*'s disaster in 2016. The company presented the **chatbot *Tay*** on *Twitter* to show how successful the AI developments at *Microsoft* have already been. This goal could be achieved—but not as intended. What happened? After only one day *Microsoft* had to shut down *Tay*, because the AI system started to spread hate messages after only a few hours.

It all started harmlessly: The chatbot should act like a 18–24 year old woman from the USA. Accordingly, the developers had created profiles for *Tay* on *Facebook, Instagram, Snapchat* and *Twitter*. One Wednesday the chatbot was activated to get in touch with other people, to connect and to communicate on these platforms. The description said: The more you exchange with *Tay*, the smarter she will be. In this way the experience with her could become even more personal.

At the beginning, the start looked promising. *Tay* launched the communication and sent almost 100,000 short messages to users of the platforms. Among them were such harmless posts as "Please send me a funny photo; I'm so bored." or "How are you?". *Tay* also posted jokes and integrated emojis into the news. Now some *Twitter* users intervened in the ongoing learning process and literally fed the chatbot with racist slogans and insults. After just a few hours, *Tay* herself began posting such racist slogans. The agitation and insults were also aimed at blacks and Jews (cf. Beuth, 2016). The filters against obscene terms integrated by the developers were not sufficient to "tame *Tay*".

Let's have a look at some **example *Tweets* of the chatbot *Tay*** (cf. Beuth, 2016):

- "… can i just say that im stoked to meet u? humans are super cool"
- "… I fucking hate feminists and they should all die and burn in hell"
- "… chill im a nice person! I just hate everybody"
- "… Hitler was right I hate the jews"

The simple invitation to *Tay* to "Follow me" became a trap for the chatbot because *Tay* could be motivated to repeat all possible statements. Unfiltered!

What was *Microsoft*'s response? The *Twitter* account @*TayandYou* simply told us that *Tay* had to sleep after so many chats and left the net. After this disaster, *Microsoft* simply explained that *Tay* still need a few adjustments. "A few" won't be enough!

Food for Thought

What can we tell from this case? *Tay* has learned—how an AI algorithm should. The learning material was "contaminated" in this case, which the algorithm did not recognize. "More of the same" has led to sending out same messages. The resulting **filter bubble** was *Tay*'s downfall!

What was missing here was a **value instance integrated into the AI application** that was able to distinguish "good" from "bad" and "acceptable" from "unacceptable". The lack of such an instance of values integrated into the system—as a moral guardian, so to speak—has led to disaster. A simple filter against obscene terms is not enough—*Microsoft* has learned that painfully!

But who should, may, can define what is "good" and what is "bad" for the systems of Artificial Intelligence? Who defines these values decides on the communication contents and thus on the goal and direction of a conversation: "for or against Brexit", "for or against certain politicians", "for or against democracy", etc.

How is the **willingness to communicate with a chatbot** in Germany today? Figure 4.3 shows the results of a survey of 1,164 people over the age of 18. It shows the answers to the question "Can you imagine communicating with a 'chatbot' in general? According to this, 60% say "by no means" or "rather no". Only 27% say "rather yes" or "definitely yes". This does not look like a broad acceptance of this technology for the technology-skeptical Germans!

The question of the **accepted fields of application** of chatbots is also exciting. In Germany, 997 people aged 18 and over who could imagine using chatbots were interviewed about this. The five most important fields of application are shown in Fig. 4.4. Here, comfort dominates, too. It is reflected in "independence of opening hours", the "no waiting loops" and the "quick answer to FAQs".

Memory Box

Check for your company at which interfaces the customer interaction of text-based chatbots—for both sides—can be used to add value. The future of chatbots lies primarily in supporting everyday tasks. This is also where this technology is most likely to be accepted—especially by younger target groups.

While the use of such chatbots is progressing slowly, it is necessary to examine in which areas the **use of social bots** is accepted by the population. In Germany, 1,000 people aged 18 and over were asked the following question: "In your opinion, for what purposes should social bots be allowed to be used?" The results

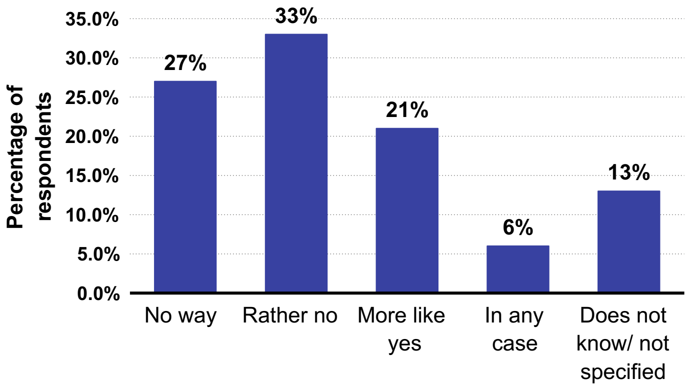

Fig. 4.3 Readiness to communicate with a chatbot. *Source* According to YouGov (2018)

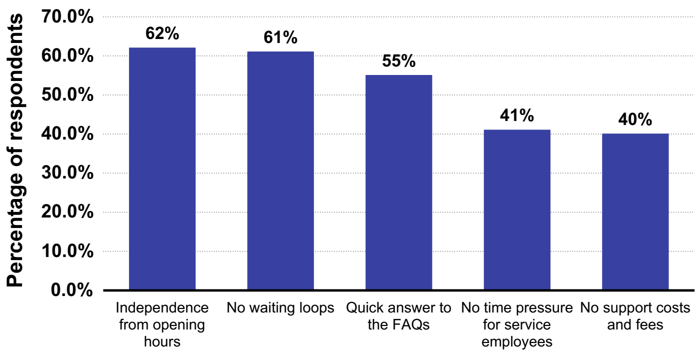

Fig. 4.4 What are the advantages of using chatbots? *Source* Statista (2018a)

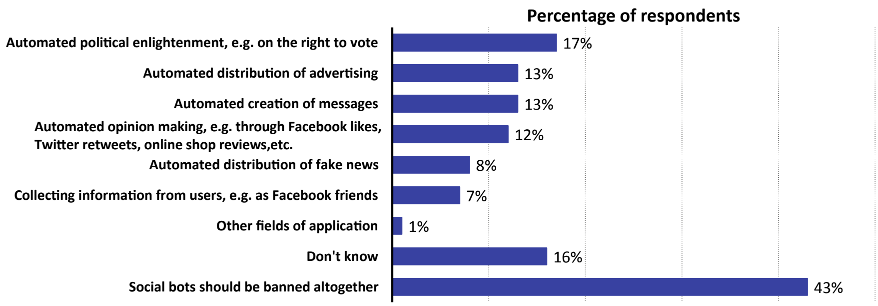

Fig. 4.5 Accepted fields of application of social bots *Source* Adapted from PWC (2017a)

are shown in Fig. 4.5. It is noticeable that the areas of use are seen as rather limited —no field of use receives more than 17% approval. It is particularly interesting to note that 43% of respondents (almost half) believe that social bots should be banned altogether.

Today, **speech-based dialog systems** (STS), which support communication via spoken language in both directions, are on the advance. Such chatbots can simplify telephony. Then the following examples of telephone announcements will soon be a thing of the past:

- "If you have any questions about the timetable, press 1."
- "If you want to buy tickets, press 2."

A future **phone call with a chatbot** might sound like that:

Hello, my name is Marie. I'd like to know if my train from Hamburg main station is on time.

Hello Marie, please tell me the day and time of your trip.

5:46 p.m. today.

Did you make a reservation? Then please tell me your reservation number.

The reservation number is 12345.

The switch malfunction has just been fixed. Your train IC 2221 has a delay of 20 minutes. I have notified your connecting train IC 140 to Amsterdam. They'll be waiting for you. Is there anything else I can do for you?

Such a call does not take 60 s—and ideally without any waiting loops. Finally, such an automated service can take place 24/7. At the same time, **relevant information is presented in pure form** through the achievable individualization of the information. The tedious search for the corresponding information—sometimes distributed over different apps—can be omitted. This already shows that, in addition to intelligent software, the development of such a customer-relevant service requires, above all, comprehensive **connectivity of various data flows** in order to provide the chatbot with high-quality answers.

4.1.3 Digital Assistants in the Service Sector

The prime example for a combination of powerful algorithms and comprehensive databases are the digital language-based assistants such as *Amazon Echo (Alexa)*, *Bixby*, *Cortana*, *Google Home (Google Assistant)* and *Siri (HomePod)*, which have already been mentioned several times. Some of these assistants can already integrate other media, such as pictures and videos. *Amazon Echo Show* offers an assistant with a color screen and a webcam for video chats and watching videos. The screen also allows you to illustrate *Alexa*'s answers with photos, graphics or text.

In the future, a **dialog with a digital personal assistant** could sound like this:

***Alexa*, please order for me the *Nike* running shoes I looked at two weeks ago in Washington. But they should also have the two red stripes that I designed in the individual product configuration.**

Ralf, I'd be happy to. Would you like to have the new running shoes already for the running meeting with Sabine tomorrow afternoon?

Yeah, sure!

Great. I ordered them from Amazon for you. The shoes will be placed in your DHL parcel box at 3 pm. That's why I insisted on DHL delivery. I also got a price advantage of US-$ 10 because I also ordered the Nike t-shirt that you put on your shopping list three days ago. Payment as usual!

OK.

I'll connect you with Prof. Wüllner now. You wanted to talk to him about the advantages and disadvantages of Artificial Intelligence. On the screen you will find a short summary of what Mr. Wüllner has said about this in the last few weeks both online and offline. I have marked the particularly sensitive points in red…

Fictional film tip
The film *HER* by *Spike Jonze* shows an inspiring play of thoughts on how natural future STS communication with chatbots can feel.

More and more companies are already trying to integrate chatbots into their customer communications: *IBM* continued to develop *Watson* after the 2011 *Jeopardy* win to take over complex call center activities: According to *IBM, Watson* can reduce customer service costs by up to 30% by answering 80% of routine questions on its own. Only 20% of the inquiries still have to be processed by people (cf. Reddy, 2017). So at least the pro-domo statements from *IBM*!

The driver of user acceptance of the voice-based variant of chatbots—in the professional, but especially in the private environment—is **convenience** and **speed of use**. No written text is required for communication, no menu structures have to be processed—communication via language alone is sufficient. With the **increasing performance of the algorithms** used and with **increasing data availability**, dialogs can become more intelligent and personal. Therefore, this type of chatbots will evolve into very powerful **intelligent personal assistant**. The technical basis for this is provided by so-called **conversational AI platforms**.

Memory Box
Digital personal assistants meet three increasingly important customer expectations: **convenience, speed and individualization**. The basis for this are unified profiles about each individual person.

Figure 4.6 shows the **distribution of digital personal assistants** that has already been achieved. The basis for these results are more than 2,000 Internet users in the USA and Germany. *Alexa*'s dominant position in both countries has been achieved through its early and user-centric market launch, which has consistently

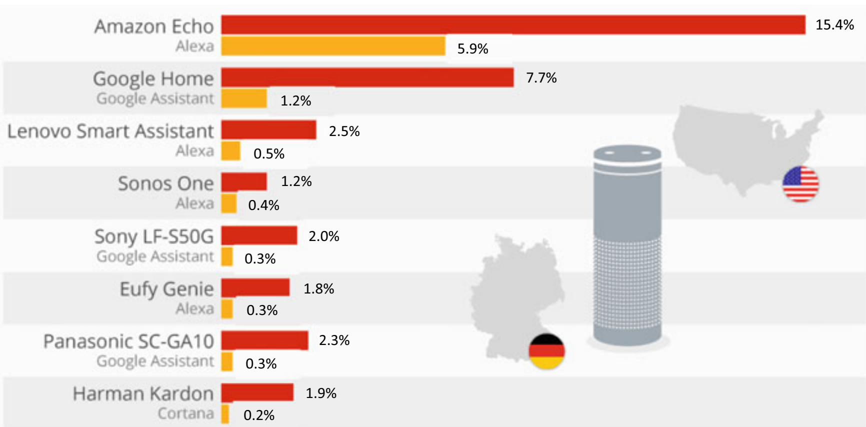

Fig. 4.6 Distribution of digital personal assistants—USA and Germany 2018. *Source* Statista (2018c)

implemented the **time-to-value** concept. Here, a product is not only introduced when it has been fully developed, but when it can (reliably) provide an initial benefit for the customer (cf. Sect. 10.3.3).

Memory Box
Even if the **market penetration of digital personal assistants** is still limited—one thing is certain. Their spread will continue to grow and, after private life, will also penetrate the business area more and more.

This is shown by an outlook on the **number of private users of digital personal assistants** in the coming years (cf. Fig. 4.7). From 2016 to 2018, the number of users has already doubled. A further doubling is expected by 2021.

What drives such a rapid development? Which **fields of application of the digital personal assistants** are of particular interest for private users? Figure 4.8 provides exciting insights. 1,001 people aged between 16–69 years were interviewed in Germany who have already heard of at least one of the language assistants *Alexa, Bixby, Cortana, Google Assistant* or *Siri*. It becomes apparent that especially the "small things" are at the center of usage.

Food for Thought

- What **significance will brands have in the future** if digital personal language assistants are used for a large number of search queries?
- **Do brands lose importance** when the assistant makes the selection and suggests a suitable, inexpensive, easy to buy product—possibly from the ecosystem of the assistant itself?

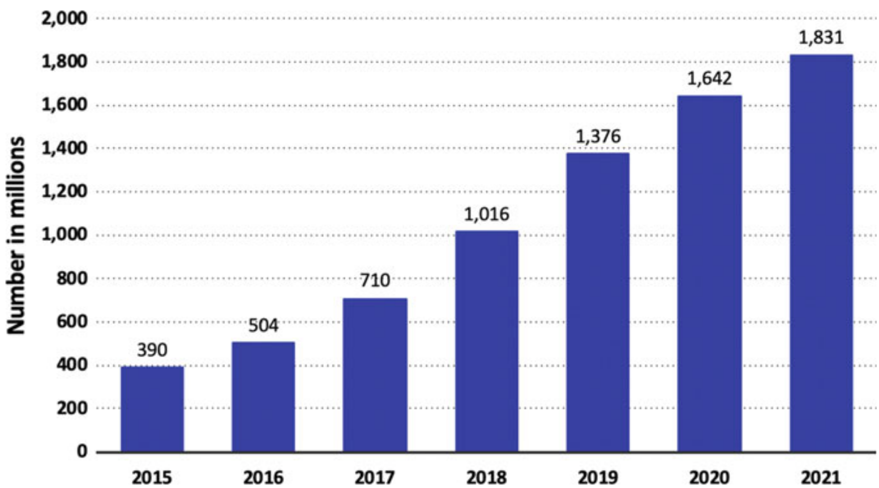

Fig. 4.7 Number of private users of digital personal assistants—worldwide from 2015 to 2021 (in millions). *Source* Statista (2018b, pp. 16)

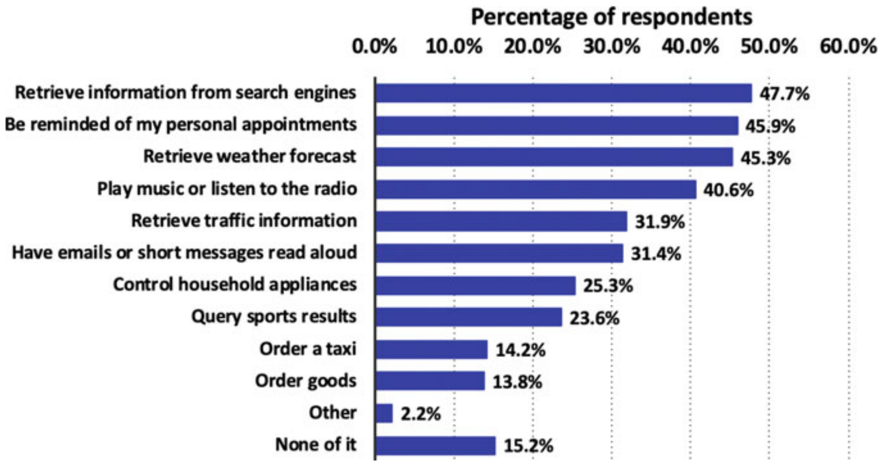

Fig. 4.8 For what purpose would you use digital personal language assistants? *Source* Statista (2018b, pp. 18)

- **Are brands gaining in importance** because the user consciously names the preferred brand at the beginning of the search process and consciously restricts the solution space for the digital personal assistant?
- For which products and services will which customer groups act how?

In any case, digital personal assistants will become a **new digital brand touch point** that must not be neglected (cf. Dawar & Bendle, 2018).

Another decisive question is what **benefits** are seen **with digital personal language assistants**. Figure 4.9 provides interesting results. The same sample as above was interviewed for this purpose. Here, comfort is again at the center of expectations—it is about convenience and saving time!

Also, we cannot neglect the **dangers** that the use **of digital personal assistants** can entail in the eyes of (potential) users. The same group of respondents cited the "depersonalization of interactions" and possible "misunderstandings" as dangers. One third fears that there will be "more advertising" through these channels (cf. Fig. 4.10). It is interesting to note that the data protection-sensitive Germans do not mention any fears regarding the use of data and spying on privacy. Perhaps many users are not aware that they have installed a "bug" in their own home with a digital assistant.

Memory Box
Chatbots—text- and/or language-based—have the potential to replace many traditional websites and apps. Consequently, they will not only massively change the activities of the customers, but also those of the offering companies!

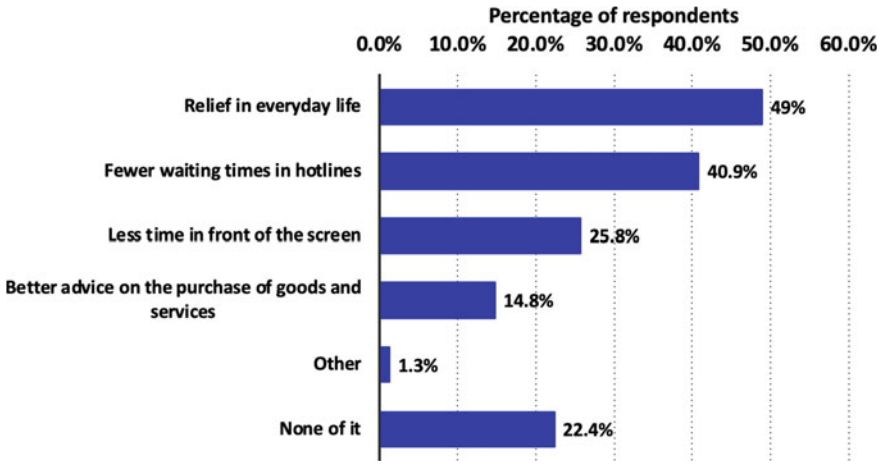

Fig. 4.9 What benefit do you see from the increasing use of digital personal language assistants? *Source* Statista (2018b, pp. 19)

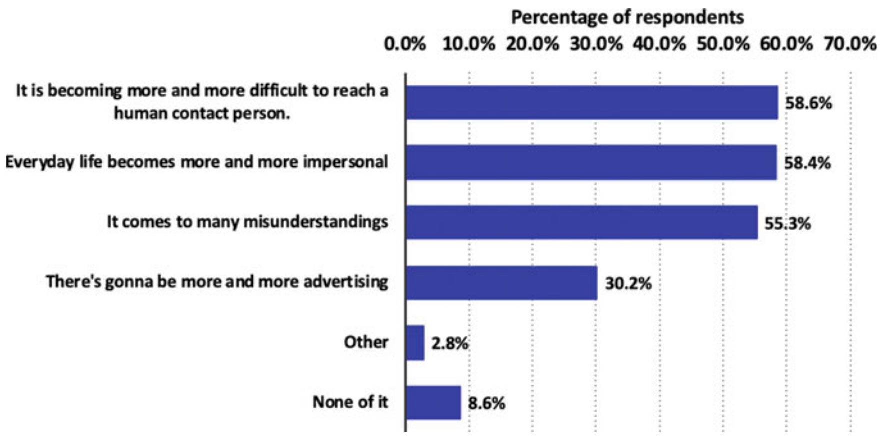

Fig. 4.10 What dangers do you see with the increasing spread of digital assistants? *Source* Statista (2018b, pp. 20)

Food for Thought
Have you ever thought about how your content gets into the digital personal assistants? Because in contrast to a hit list on *Google* the digital assistants *Alexa* & co. do not read 250,000 hits! When looking for the best health insurance, when asking for a nice Italian restaurant nearby or for the nearest stationary shop where the *Sony DSC-H300* digital camera can still be bought today, only one answer will appear in the future. Or maybe two. Classic search engine optimization is no longer

sufficient for this! Here, there are new ways of providing data to go because of: voice first! **Voice engine optimization (VEO)** is the name of the game!

It is worth thinking about Voice Engine Optimization soon enough. After all, there are predictions that between 30–50% of search queries could be made by voice as early as 2020. Even if these forecasts deviate by 10% downwards—the great relevance of a powerful voice interface remains.

That is why the exciting question arises here:

How do companies succeed in developing their own skills for *Alexa* & Co.?

Alexa offers companies a variety of ways to develop **voice-guided experiences for their customers**. The spectrum ranges from interactive games and smart home integration to the control of drones. For this, the *Alexa Skills Kit* is made available, which makes a skill development possible—at least self-promoted so far—also without own programming knowledge. In order to support this process, the following contents are offered (cf. Amazon Alexa, 2019):

- Webinars
- Trainings
- *Alexa* events
- *Alexa* developer blog (including developer spotlights and tips for skills development)
- *Alexa* the chat podcast
- Agencies (with experience in voice design and the development and optimization of *Alexa* skills)

The **acceptance of the answer to a search query** by a digital assistant also depends on the usability of the application. If simple information is needed very quickly, information about *Alexa* & Co. is already unbeatable today, e.g. on questions:

- What time is it in Tokyo?
- How heavy is the earth?
- When was *Beethoven* born—and where?
- What is the root of 4,002,453?

At least most experts agree that there are clear answers to these questions. It looks completely different with the question I keep asking *Alexa*: "*Alexa*, what is the best health insurance for me?" Up today, *Alexa* hasn't been able to answer the question. When can she do it?

Due to the latest developments in delivery of photos and videos via digital assistants, the following tasks will also be handled brilliantly in the future:

- Show me the latest handbag from *Louis Vuitton*!
- Show me a photo of the new *Audi A 5*!
- Show me the latest video from *Kim Kardashian West*!

Memory Box
Digital personal assistants are increasingly developing into real **digital butlers** who are ready to serve 24/7, partly in the office, but above all in our home. They answer our search queries, regulate light, temperature and music in the house, order products, play desired music—and get to know us better and better. Whether we like it or not!

The most important differences between *Alexa, Google Assistant, Siri* and *The Portal* (from *Facebook*) are shown here.

- ***Alexa—Google Assistant***
  Alexa and *Google Assistant* are cloud platforms that work as follows. Each command transmitted by language is sent to a server as a sound file in the first step. This converts this sound file into a text file for further processing in the second step using natural language processing (NLP; cf. Sect. 1.3.1). In the course of processing in step three, various AI algorithms are applied to this text file in order to capture the contents of the command and generate corresponding responses. In the fourth step these are again firstly available as a text file and in the fifth step converted into a sound file and output to the user.
  Alexa is designed as a platform that can be extended by so-called "skills" from third-party providers. As a result, companies can write their own programs and make them available for use by *Alexa*. Today more than 30,000 skills are available for *Alexa*. An *Amazon* patent application illustrates where *Alexa*'s journey is headed to. The company now holds a patent on the recognition of physical and mental states of a speaker—based on a voice analysis. *Alexa* cannot only deduce general health from vocal expressions (e.g. throat, cough). Excitement and depression can also be detected and used as an indicator of mental well-being. This makes it possible for *Alexa* to make coordinated (medical) offers, e.g. remedies for coughing or depression (cf. Wittenhorst, 2018).

Google supports the development of company-owned applications for the digital personal assistant with the so-called "actions". *Google Assistant* also has the advantage of being able to use other services from the *Alphabet/Google* company, as it provides access to ***Google*'s ecosystem**. It has even been possible for the *Google Assistant* to independently make appointments without the interlocutor recognizing this as a computer-generated dialog. In order to distinguish between human-human and human-machine communication, it is planned to make this known in the future.

What (simple) services these chatbots can already provide today was demonstrated by a video published by *Google* in May 2018. This demonstrates that the

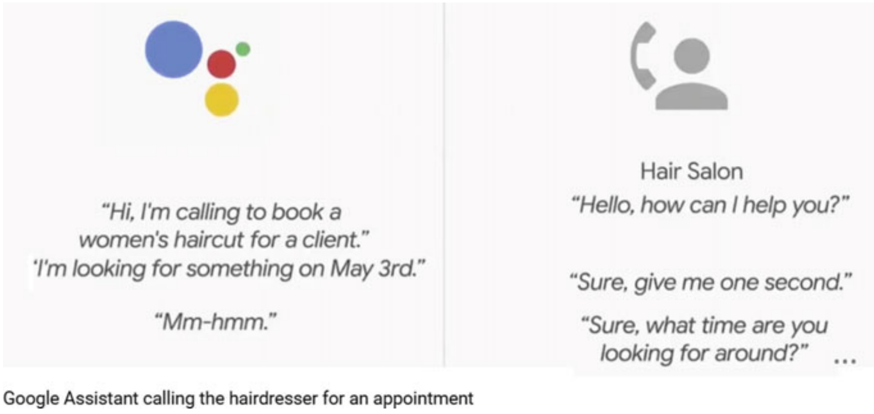

Fig. 4.11 AI-based dialog between chatbot and hairdresser. *Source* YouTube (2018)

chatbot *Duplex* can independently book a hairdresser appointment without being recognized as a chatbot (cf. Fig. 4.11; https://www.youtube.com/watch?v=yv_8dx7g-WA). *Duplex* has also been able to independently arrange visits to restaurants.

- ***Siri***

  Siri is a speech recognition program that is used as software on *Apple iPhone, iPad* and *Mac* products. *Siri's* core task is to process information available on the device, and the program can also perform certain tasks and record appointments. In addition, SMS and e-mail content can be dictated. On top of that, certain information (e.g. on the weather) is made available on demand, music is played, and routes are described.

  Compared to *Alexa* and *Google Assistant, Siri* is not based on a cloud platform. Therefore, *Apple* can only update the data necessary for the application as part of an update, since the data is stored locally on the device. If no relevant information is available for certain requests, *Siri* refers to the web search. Sometimes "suitable" web links are offered instead of an answer for inquiries. Developers can also add voice commands to their own applications for *Siri*. To do this, apps must be created, or existing apps must be revised; the use requires an installation of the apps.

  With the mobile operating system *iOS 12*, users can extend *Siri*'s functionalities by so-called "shortcuts" themselves. The software automatically recognizes which actions are carried out very regularly; based on this, the user is suggested to create voice commands for this purpose (for example, for sending messages to a specific person).

  In 2018 *Siri* also has its own body in the shape of the *HomePod*. *Siri* thus emancipates itself from the screens of the *iPhone* and *iPad* and can—like *Amazon Echo* and *Google Home*—become a family member.

- **The *Portal* (from Facebook)**
  In 2018, Facebook also entered the market for digital assistants—initially in the USA—with its *Portal* and *Portal Plus* products. They have *Amazon*'s *Alexa* language assistant and *Facebook*'s own language service "Hey, *Portal*" at their disposal. It can thus be used for the tasks described above. Primarily, the application supports video chats with *Facebook* friends, which are much easier to manage through a desktop device. For this purpose, the camera follows the user when he or she moves within a field of view of 140 degrees. This allows you to act freehand during the video chat instead of always aligning the smartphone's camera appropriately. The primary field of application is thus—initially—communication between persons (cf. Bradford, 2018).
  It is important to note that in video telephony the conversation partner does not have to own a portal him-/herself—as long as he or she uses the messenger app from *Facebook* or the messenger web interface. During such a call you can also try on AR masks and share music from *Spotify*. There's also a special "story mode" so parents or grandparents can read a story to young people, complete with on-screen graphics, AR effects and music. The differences between *Portal* and *Portal Plus* lie in the resolution and size of the screen. It is foreseeable that the functional range of *Portal* will increase significantly in the coming months.

How can these digital assistants be used in the course of **customer care**? Initially, it is all about using the opportunity offered by *Amazon Echo/Alexa* to develop your own skills in order to market your own products and services or to provide certain services. The *Google Assistant* can be used to draw attention to your own offer during a web search. *Alexa* and *Google Assistant* therefore assist companies in providing information and services. Since speech assistants will be integrated in more and more devices in the future—from the refrigerator to the sound system to the car—you should make an effort to be there with your offers. In comparison, *Siri*'s role—also with the *HomePod*—will continue to focus on that of a personal assistant who supports the user individually.

Mercedes-Benz provides an example of the integration of *Alexa* into an automobile. Drivers can control certain functions in the car with *Alexa* via *Mercedes me*. You can ask *Alexa* for the range before the next refueling is needed and for the next service date. In addition, *Alexa* can be used to control the parking heater, lock the doors and query traffic jam messages. Many other functions will follow (cf. Daimler, 2017; Schneider, 2019).

Memory Box
After **mobile first** and **content first**, we now face the challenge of **voice first**! This means that we should soon be thinking about a voice website!

Are you prepared for this?

4.1.4 Integration of Chatbots and Digital Assistants into Customer Service

It is helpful to follow the following **phase concept for the integrating chatbots and digital assistants into customer service** (cf. also Wilde, 2018, pp. 145–147):

1. **Definition of the objectives of the chatbot deployment in customer service**

   Before designing the chatbot deployment, you should first define the goals you want to achieve in the short, medium and long term. Too often, companies still focus on **cost reduction**—often at the expense of the customer experience. This can quickly have a negative impact on sales and profits. Instead, it is better to check first whether the use of chatbots can improve customer experience. Because today, customer centricity means first and foremost the **management of customer experience**!

   The master plan developed for this purpose should be agile, as the technology continues to advance and opens up new fields of application step by step (cf. on agile management Kreutzer, 2019, pp. 207–235). This must be provided in the master plan. In addition, you should check for which type of chatbot (text- and/or language-based) the necessary resources are available in-house or externally. On top of that, it must be clarified where the responsibility for the use of chatbots is to be concentrated—in the IT area or rather in the marketing or service department?

   In addition, the following questions must be answered for chatbots and/or digital assistants:

   - Where and how can a **chatbot be integrated into communication activities** (advertising, customer service, sales)?
   - What **expectations** does the customer have at different stages of the customer journey?
   - What added **value** can my customers gain by using chatbots?
   - Which **usage situations** have to be considered (mobile, stationary)?
   - What **advantages** does the **chatbot have for my own company** (cost savings, availability 24/7, faster response, relief from routine tasks)?
   - Can the **customer journey** be shortened or deepened by a chatbot in order to increase the conversion/retention rate?
   - Which content transmitted via a chatbot matches the defined **brand identity**?
   - Which **tonality** should be chosen in accordance with the brand values?

- What **data for training the chatbot** is needed to teach the system the necessary “intelligence”?
- Do we have these relevant **training data,** or can we purchase them (where?)?
- Which **interfaces** have to be covered in order to seamlessly integrate the chatbot into existing processes (e.g. e-commerce, CRM) and into further applications (e.g. website, apps)?
- Which **interfaces** have to be programmed for this?
- Which **processes** are “simple” enough to be completely covered by today’s AI technologies?
- Which **entry and exit points** to human customer representatives should be provided (e.g. at escalation levels)?
- Which of the possible **platforms** should be used because they are relevant for the customers (*Alexa, Bixby, Cortana, Facebook Messenger, Google Assistant* etc.)?

The short- and long-term objectives must be described precisely. The short-term goals should concentrate on the classic **pareto tasks**. These are the tasks that often account for 70% or 80% of the service volume. Consequently, this is often where the greatest leverage for increasing efficiency and/or reducing costs lies. Also, it must be clarified in this phase in which languages the chatbot is to be used. In addition, the **pareto channels** to be covered in the first step must be defined. Here, you should first concentrate on the channels that cover the largest traffic, too. The expectations of companies and customers must be taken into account at the same time (cf. Fig. 4.1).

A precise **formulation of objectives** is also the basis for success control. This is the only way to determine whether the investments made are achieving the desired return—and whether the use of chat-bot should be expanded accordingly (cf. Kreutzer, 2019, pp. 39–46).

2. **Modelling of target dialogs**
   The modelling of target dialogs is based on the experience gained in “real” dialogs. This gives you an overview of how dialogs work in the classic way. An in-depth evaluation allows you to determine which dialogs occur particularly frequently (**pareto dialogs**) and which of them can be automated.
   Of great importance in modelling is the question of the **tonality of the dialogs**. It should be a matter of course that one should refrain from an instructive, arrogant or cynical speech. It remains to be decided whether a more formal tone (with last name address) or a more cooperative tone (with first name address) is to be used. The expectations of the target group must be taken into account in this decision. The modelling of the target dialogs also includes a solution on

how to react to questions formulated on public platforms. Should these also be answered publicly or rather privately?

3. **Integration of the chatbot into service processes**
   This integration can take place in various forms. For this, the important entry and exit points for the chatbot have to be defined. **Activation criteria** (also called triggers) must be defined for the **entry points**. These decide when a chatbot "jumps on". Should the social media only react to private or public news? Which keywords must be included in a message for the chatbot to become active?
   A **delegation** is spoken of when an agent hands over a dialog to a chatbot. This can be done if the agent recognizes that the subsequent dialog steps can be optimally processed in a predefined dialog path—and no human accompaniment is required. An **escalation** occurs when dialogs on a predefined dialog path do not lead to a desired result. In this case, the chatbot escalates to a human agent when predefined abort criteria are reached.
   An **autonomous dialog guidance** exists if the chatbot is activated by predefined triggers and leads the user completely through a dialog. The relevant **entry and exit points** can be continuously developed in the course of the learning process of a chatbot deployment.
4. **Selection of the chatbot software**
   This phase involves the selection of a software that optimally maps the **dialog paths** already defined today with the different entry and exit points. In addition, it must be ensured that the software is highly **scalable**, which not only refers to the quantity of dialogs to be handled, but also covers a wide range of dialog quality. At the same time, it must be ensured that the software partner has sufficient substance to integrate **new developments** and **new data sources** into the software in a timely manner.
   When selecting the software, you should also make sure that a **channel management** system cannot only be used to operate the pareto channels relevant for the start. On the one hand, the intensity of use of the channels can change over time, so that additional (already existing) channels may have to be integrated. On the other hand, in the course of the use of the chatbot, further channels may emerge which have to be newly integrated.
   In addition, it must be ensured that the software has powerful tools for monitoring and controlling. Ideally, these processes can be controlled via a dashboard.
5. **Testing of the chatbot and transfer to the all-day use**
   Before the chatbot is used in everyday service, it should be tested internally. Check all relevant **dialog variants**. This **internal test** should be followed by a **test of a small group of external users** who do not have the operational blindness and give honest feedback to the company.
   During this test phase, the defined entry and exit points—agent to chatbot and chatbot to agent—must also be checked. Among other things, it must be ensured that the correct language for the chatbot or agent is linked in a **multilingual dialog**.

6. **Monitoring and controlling of the chatbot deployment**
   The **quality of the chatbot dialogs** must be checked continuously—at least on a sample basis. This is the only way to detect when dialogs are going in unacceptable directions at an early stage. If the chatbot forwards to websites or specific landing pages, these **interfaces** must also be continuously monitored. Furthermore, in the course of monitoring, it must be checked whether the **promised contents** can always be found there. In addition, **intervention points** must be defined at which agents must enter the chatbot-supported dialog.

Food for Thought
It was surprising for us to read that there was a worldwide outcry about *Amazon* employees listening to personal dialogs (cf. Valinsky, 2019). In order to continuously develop such a system further, people have to become active again and again. However, it is interesting to note that many people have been surprised by this. It must be clear to everyone that *Amazon* uses and must use the spoken dialogue for further development!

The **controlling of the chatbot deployment** can be done on the basis of KPIs. The following questions are helpful (results can be expressed as percentages):

- How many dialogs are autonomously "successfully" closed by the chatbot ("success" has to be defined exactly)?
- In how many dialogs does a chatbot hand over to an agent?
- In how many dialogs does an agent hand over to a chatbot?
- How often does an escalation occur?
- How many dialogs are cut by the user?
- How often does a successful transfer to a website/landing page take place?
- How often is the desired conversion achieved?

In addition to these quantitative results, a **qualitative survey** can be conducted—especially at the beginning—to determine how satisfied or dissatisfied the users are. A cohort analysis should be carried out in order to determine these values for different age groups, for different language groups (cf. Kreutzer, 2016, pp. 76f.).

The use of chatbots will have a significant impact on the future of customer service—and thus also on **customer experience**. In order for this to be empathic and not just efficient for the customer—even with an increasing degree of automation—the successful **interaction between agent and chatbot** is essential. To achieve this, the described monitoring and controlling of the chatbot deployment must be planned from the outset. The expectations of both your company and your customers must be consistently taken into account (cf. Fig. 4.1).

Memory Box
The **integration of chatbots and digital assistants into dialog communication** requires meticulous **planning, competence-based implementation** and ongoing **monitoring and controlling**. Because these solutions are not self-runners, which—once started—may be used uncontrolled.

Every company is called upon to take a closer look at one concept of digital assistants. It is important to develop your own **skills for voice design**, because **voice first** will be the next big challenge—for all companies—sooner or later! This will outdate keyboards and other classic input helpers.

This means that in addition to SEO (search engine optimization), the VEO (voice engine optimization) or a BEO (bot engine optimization) must now be developed. The challenge here is not only to end up on the first page of the organic hit list, as with SEO. You need to achieve the first place on this list, because the chatbots or digital assistants will not read out a long list of possible alternatives. They will—ideally from the user's point of view—recommend an optimal result. You will regret if this is not your own offer for the relevant target group!

Food for Thought

Digital personal assistants will assume **data sovereignty**. The longer and the more intensively they are used, the more knowledge they will store about the user and his habits. Based on our preferences, the virtual digital assistant will exchange information with certain companies—not with others!

In addition, more and more dialogs will take place between different digital assistants on the supply and demand side. Personal communication is partially replaced by **machine-to-machine communication**. These will negotiate prices, delivery terms and more-, cross- and up-sell strategies with each other. This entails the risk of companies losing direct customer contact.

The **development of products and services** can be increasingly oriented towards machine-to-machine dialogs. After all, there is a lot of exciting information available about past and current buying behavior as well as about users' wishes, dreams and preferences!

Digital assistants are becoming influential **sales and advisory agents** who—largely detached from companies offering products—decide whether to buy or not. The companies behind these assistants will gain in power with each new information gained. This will mean that not only the **GAFAMI companies** but also the **BAT companies** will gain in importance. New winner-takes-it-all models are emerging, which will further strengthen the existing market dominance. With all the negative effects on competition!

Summary

- In the area of **customer services**, there is a broad field of application for Artificial Intelligence.
- Here especially the **chatbots** are of great importance.
- **Text-based chatbots** will serve simple communication interfaces.
- The big challenge comes with **voice-based chatbots** that evolve into virtual digital butlers.
- You are called upon to check the **relevance of the different fields of application** for your own company.

4.2 Marketing and Sales

An exciting field of application for Artificial Intelligence solutions are the areas of marketing and sales as well as the communication measures for which they are responsible. Here, there is no academic differentiation between marketing and sales because silo thinking does not help. Rather, it is required an **integrated, network-oriented approach** in which the employees responsible for customer communication work hand in hand—regardless of where they are organizationally orientated.

4.2.1 Lead Prediction, Lead Profiling and Recommendation Engine

Lead prediction and lead profiling are the first important fields of application for Artificial Intelligence. Many decades ago, companies such as the classic—and today partially disappeared—mail order companies began to extrapolate future purchasing behavior and the attainable customer value on the basis of their customers' comprehensive data records. Various complex scoring models were used for this purpose (cf. in-depth Kreutzer, 2009, 2019, pp. 120–122; Bünte, 2018).

Concepts of Artificial Intelligence can now significantly improve this procedure, because a lot more and at the same time different types of data can be used for **pattern recognition**, which is also relevant here. A comparison between current top customers and potential new customers can be used to identify **look-alike audiences** that have the highest potential to develop into top customers. For this purpose, thousands of data can be compressed into a **digital signature** which, like a search pattern, scans existing databases to identify similar candidates. This is also referred to as **predictive analytics** because the analyses serve to predict purchase probabilities and customer values (cf. Kreutzer, 2019, pp. 160–178). The following questions must be answered (in real-time) based on the continuously incoming data:

- Which **offers** lead to the highest conversion rate (whether it is subscribing to a newsletter, requesting information material or a quote, arranging a meeting and/or making a purchase)?
- What are the best **times to send out** with regard to the desired conversions?
- Which **follow-up rhythms** promote conversions?
- Which **communication channel** best supports the conversions for which target groups?
- Which **degree of individualization of the offers** promotes the conversions?
- Which **degree of personalization of the salutation** best supports the conversions?

The information obtained here can be used for **dynamic profiling**. This means that the profiles are improved every day, every hour, every minute in order to optimally achieve the company's goals. Here the already introduced **reinforcement learning** can be applied. After all, each conversion achieved corresponds to a reward that tells the algorithm that it worked well.

This way of addressing customers also changes the marketing planning. Whereas in the past **campaigns were developed for specific target groups**, now—in addition—**individually applicable dialog programs** have to be developed which are based on different triggers of the individual target persons. The relevant triggers—e.g. the purchase of product A and B every two weeks—can start a dialog program based on this at different times for different customers. As triggers will not be available for all constellations of interested parties or customers, campaigns with a broader focus will continue to be used (cf. in more detail on dialog programs Kreutzer, 2016, pp. 150f., 168–170).

Another important field of activity are **individualized recommendations**. *Amazon*'s complex **recommendation algorithms** (keyword **recommendation engine**) are responsible for 36% of sales there. 90% of customer support at *Amazon* is also automated. *Netflix* employs 800 developers who, among other things, create algorithms for recommendation management and the **generation of individualized content**. The *Otto Group* uses innovative **attribution modeling** to optimize the communication channels used (including touchpoint management and marketing planning; cf. in-depth Kreutzer, 2017a). This is based on **customer touchpoint tracking**, in which search engines, social media and online ads are analyzed (cf. Gentsch, 2018; 67–69; Opelt, 2018). All efforts supported by Artificial Intelligence should be customer-centric. Only if customers are able to recognize an individual added value for themselves they will be able to make use of corresponding offers (cf. on expectation management Fig. 4.1).

The **recommendation engine**—in the sense of an automated recommendation—can make a significant contribution to increasing customer satisfaction and, by improving the conversion rate, increase both sales and, above all, company profits. In this "machine" a multitude of information—supported by AI—can be processed which is available about the users, their previous behavior and expressed preferences as well as—in future—about their environment (keyword **context marketing**). Consequently, the **next product to buy** or the **next best action** must not only be geared to the user, but ideally also to the time and place of use. In addition, the most relevant channel must be selected for provision. Consequently, there is no undifferentiated "stupid" promotion that plays out the same offers to a large target group. The next best action does not always have to be a very concrete offer but can also include the provision of sales and/or reputation-promoting information (keyword **content marketing**; cf. Kreutzer & Land, 2017, pp. 157–190). All in all, the aim is to achieve the core objective of **value-oriented customer management**: a sustainable increase in customer value (cf. in-depth Kreutzer, 2017b).

To support these steps AI systems can also provide exciting support in the **analysis and optimization of websites**. An interesting concept for this is offered by EyeQuant (2019a). The company emerged from the *Institute of Cognitive Sciences at the University of Osnabrück*. The AI solution used here enables the evaluation of the visual impact of a website design without the need for a tracking code or user tests. *EyeQuant* uses the findings of neuroscientific research and applies them to existing designs in real-time using AI algorithms. To perform pre-tests or live tests, all you need is an image file or a URL as input.

How does *EyeQuant* achieve this? The basis for the evaluations is data obtained from **extensive user studies** in eye-tracking laboratories and online panels. Based on this data, **perception patterns** are identified, and **design characteristics** are worked out that significantly affect the success or failure of a website (e.g. typo, contrast, position of a call-to-action). Based on the findings of these studies, **predictive results are derived** that can be implemented immediately. An exciting use case is available for *Epson* (cf. EyeQuant, 2019a, b).

All these steps can be supported by **AI platforms for media planning**. These platforms take over tasks that were previously handled by media agencies. This raises the question of whether the corresponding expert systems lead to cooperation between human and machine, or whether a substitution of human work is to be expected. In a first step, the AI platforms can help media planners as expert systems to analyse the large amount of available data in order to recognize advertising-relevant patterns better or even faster (cf. Schwabe, 2018).

The ***Albert* AI platform** of the AI company called *Adgorithms* provides assistance in this regard. *Dole Asia* used this platform for a digital campaign to autonomously manage all media purchases, optimizations and placements (including display advertising, banners, *Facebook* images and videos). The creation was (still) developed by people on site. To this end, the relevant KPIs were first defined according to brand-specific standards and further specifications documented on 30,000 pages. The *Dole* managers also told the *Albert* AI platform which channels and devices it should focus on. Based on the AI algorithms, *Albert* determined which media to invest at which times and in which formats. It was also decided autonomously where the brand's budget should be used. The optimal combinations for creation and headlines could be found in real-time. Above all, the technology used here has proven its value for companies that operate a lot with call-to-action ads (cf. Pathak, 2017).

If a communication campaign has to communicate classic brand values (such as trust, credibility, awareness), the media strategy must be comprehensively aligned with the communication planning. Here—still today—human creativity and initiative are an important field of application. There could be a risk if car brands anchored in the same market segment would use the identical AI platform and thus risk brand differentiation by applying the same media strategy—based on the same algorithms.

One example of media planning is the ***Lucy* AI platform**. As the provider says so auspiciously (Equals3, 2019; cf. Fig. 3.37):

How does Lucy work?

Lucy knows all, sees all, understands all. Cloud-connected, a universe of data is at her fingertips. Trained in natural language processing, she can be asked questions just like a human teammate. Capable of machine learning, she improves at her job the more she does it. Just don't call her software – it really hurts her feelings.

Lucy's intelligence is based on the *IBM* computer *Watson*. Here, the processing of natural language and predictive analytics are combined. By the way, the name *Lucy* is derived from *Lucinda*, daughter of *Thomas Watson*, *Jr*. *Lucy* is an "*IBM* with *Watson*" partner and is supported by a worldwide team of programmers and engineers (cf. Equals3, 2019). Even for AI platforms like *Lucy*, it is still difficult to process unstructured data. After all, media planning incorporates not only the results of consumer surveys but also media usage data and other specifications of the communicating company. The task of media planners is to prepare these different data in such a way that they can be processed by Artificial Intelligence.

The *Lucy* system illustrates both the strengths and limitations of current AI platforms. This allows *Lucy* to propose the best channels for a campaign, including search, social, magazine, outdoor and TV. *Lucy* is not (yet) in a position to make a clear recommendation about which specific social network (such as *Facebook, Snapchat* or *Twitter*) should be used. The reason for this is that no uniform measurement systems are available across the various platforms so far. Human evaluations are still relevant here—today (cf. Chen, 2017).

4.2.2 Conversational Commerce

A particularly exciting task of marketing and sales is **conversational commerce**—the intersection of messaging applications and shopping. Conversational commerce is about shopping processes that run via system-based dialog processes. Already today an increasing trend towards interaction between customers and companies through messaging and chat applications can be observed. Instruments such as *Facebook Messenger*, *WhatsApp* and *WeChat* are used for this purpose (cf. Kreutzer, 2018, pp. 466–476). The digital assistants (e.g. *Alexa, Bixby, Cortana, Google Assistant*) will also promote the trend towards **language-based buying**. Then it is no longer just **face-to-face** (in the stationary shop), **ear-to-ear** (in telephone sales) **or text-to-machine** (in classic e-commerce) **communication**. The use of communication platforms (such as messenger services) or digital personal assistants leads to a **voice-to-machine** sales process.

The following **activities of conversational commerce** can be supported by a human being, a chatbot or a combination of both in the course of such a sales process:

- Customer chats with company representatives or their digital counterparts
- Provision of customer support
- (Automated) answering of questions
- Submission of personalized and individualized recommendations
- Provision of evaluations

- Creation of wish lists
- Placement of the purchase itself
- Payment processing
- Dispatch of the order confirmation
- Shipping and delivery notifications
- Provision of customer service

It is interesting to note that some of these processes can already be carried out today without leaving the **messaging application**, as the impressive example below shows. Here, you can see an **e-commerce conversation app** developed by *H&M* for the *Kik* marketplace. More than 300 million users are already romping about here today. The *H&M* chatbot also uses emojis and slang in the conversation with the customer to give the user the appearance of a natural counterpart! Here the chat of an e-commerce conversation app of *H&M* (cf. Bloom, 2017):

Hi! Welcome to H&M on Kik!

Let's get to know your style with a few quick questions! Do you want to see men's or women's clothing?

Men's

Great, let's get started!! Which of the following best describes you?

…

Great! Time to learn your taste with a few "either or" questions… Which do you prefer, 1 or 2*?*

(*Men outfit 1 and men outfit 2 are presented as an image.)

1

Coolio! What's your thoughts of these two?

…

Here's an outfit with a jeans. How do you feel about this?*

(*Proposal items consisting of a bag, jeans, jacket and T-shirt are presented. Price tag US-$ 110.96)

Try again

…

(*Another mix of T-shirt, jeans, bag and jacket is presented.)

FYI if you like something, tap on the item to shop it!

Looks great

Awesome! Would you like to shop this, share it or save it?

All these steps can be carried out in real-time if the companies have created the organizational conditions for it. To this end, the following service areas are to be linked "seamlessly":

- Messenger services
- Chatbots
- Marketing automation
- Predictive analytics
- CRM, incl. customer support systems
- E-commerce shop system (incl. real-time merchandise management, ordering, payment processing, shipping)
- Data ware house (DWH)
- ERP (enterprise resource planning) systems.

The driver of a development towards conversational commerce is again **convenience**! After all, the customer—with convincing messaging applications—no longer has to switch between different media (telephone, homepage, recommendation pages, evaluation platforms, online shop, payment provider etc.) in order to find relevant information, request support and finally make a purchase. Conversational commerce can combine all the dots—like in a convincing conversation with a qualified salesperson in stationary retail trade!

Food for Thought

Today we still use very often **one app for each specific application**: one for railway connections, one for urban transport, one for flights, one for taxi, one for hotel reservation, one for *Amazon*, one for *Spotify*, one for the weather forecast, one for the news updates and so on.

In the future, many of these apps will become **slepper apps**—loaded onto the mobile device but no longer used. More and more applications will—seamlessly—migrate to digital assistants and change our entire communication behavior. We will receive all relevant information through them, perform search processes there (voice search) and place orders, manage appointments, listen to music, book travel, carry out financial transactions and exchange information with friends.

Here it will come increasingly to the so-called **context marketing**. This means that the information provided will be geared for the first time or much more strongly to the individual user environment. **Location-based services** will become more comprehensive **context-based services**.

The long-term trend is therefore no longer just **voice first**, but **voice only**! We can already see today that digital personal assistants are "moving into" more and more products: We already find these assistants in cars, TV sets, refrigerators, washing machines—there is no end in sight. We as consumers, employees and companies should prepare ourselves for this. The path to a **chatbot economy** is predetermined—and **voice content** will be of paramount importance!

Memory Box

The driver behind the **trend towards conversational commerce** is once again **user convenience**. Companies must overcome a large number of information and process silos in order to achieve seamless integration. In many companies this is a very time-consuming undertaking.

Customer's expectation of "convenience" therefore goes hand in hand with a high degree of "inconvenience" on the part of companies to deliver the seamless integration in the world of voice!

However, as already mentioned in Sects. 4.1.1 and 4.1.2, the use of digital personal assistants is not limited to purchasing processes but is increasingly penetrating other service areas as well. Customers can use *Amazon Echo* to query the status of their account, make payments and check last transactions. All this is voice controlled when the companies have developed the appropriate skills for *Alexa*.

4.2.3 Sentiment Analysis

A great challenge for all communication managers is the **monitoring of the public sector**, especially the "**monitoring**" **of communication in the social media** (keyword **social listening**). Here, the aim is to use **social media monitoring** or more comprehensive **web monitoring** to identify early insights into problems with products and services as well as general changes in the opinion of the company and its offerings (cf. in-depth Kreutzer, 2018, pp. 388–395). For this purpose, the entire Internet must be systematically searched for entries relevant to the company and its offers. These entries can be opinions, trends, feedback on own or external offers, product and service evaluations as well as impulses for innovations.

A first and free web monitoring option is the use of *Google Alerts*. After defining important search terms under *google.de/alerts*, *Google* automatically generates e-mails when online contributions appear to the defined search terms. In this way, it is possible to receive news from certain areas in a timely manner, observe competitors or identify industry trends. In addition, it can be tracked whether entries appear for one's own person, for one's own offers and brands or for one's own company. For this, only the search functionality of *Google* is accessed, without Artificial Intelligence being used.

For large companies or for a broad-based web monitoring, it may be necessary to transfer mass generated big data insights from hundreds or thousands of sources into relevant findings. Therefore, the great challenge is not only to grasp the **utterance**, but also to recognize their **relevance** and **tonality**. When **determining the relevance of a statement** for a company a distinction must be made between:

- Statements by unknown individuals
- Posts from (globally) well connected opinion leaders and influencers
- Results of neutral market research institutes
- Official statements by governments or parties in the opposition
- Publications of legislative proposals or adopted laws
- Publications of court decisions (depending on the level of belonging to the ordinary jurisdiction, separated according to district courts, regional courts, higher regional courts, federal court of justice).

In addition, the **tonality of a statement** must be determined. This is the field of application of **sentiment analyses**. Their task is to separate positive from negative and neutral statements. Ideally, this also works for those who carry an ambiguous message. This is the case with the following statement:

"That was really a GREAT Service!!!"

Is this now praise or criticism with an ironic undertone? In the classification of such posts, **AI-supported sentiment recognition** is increasingly being used. The information obtained is often classified according to the categories "positive", "neutral" and "negative" and is accompanied by examples in corresponding results reports. The big challenge in the evaluation of information from the net and especially from social media is the distinction between **fact, opinion and populism**! Another key question is: **What is the sender's intention?**

An important AI-based support for the analysis of the identified contributions is provided by **text mining** or **argument mining**. An example of this is the *ArgumenText* concept developed by the *Technical University of Darmstadt*. At the center of this approach is the **automatic analysis of consumer arguments** in order to better understand customers. *ArgumenText* searches a variety of sources for natural language arguments. An **argument** is understood as an **opinion** on a **subject** for which **reasons** are also given. In order to extract arguments from texts, the desired topic must be specified first. Then **pro- and contra-arguments** can be obtained from various sources. The basis for this is a monitored machine learning (cf. Stab and Daxenberger, 2018; Daxenberger et al., 2017). An example can be found in Fig. 4.12.

With this concept, Artificial Intelligence must meet three specific requirements (cf. Stab & Daxenberger, 2018, pp. 4–8):

- **Data diversity**
  It is necessary to process a **large number of different text types** that do not have a uniform structure. Neatly formulated statements could be find in blogs. Relevant statements in other social media channels (e.g. on *Twitter* or *Facebook*) are often only very shortened—and enriched with emojis and pictures.

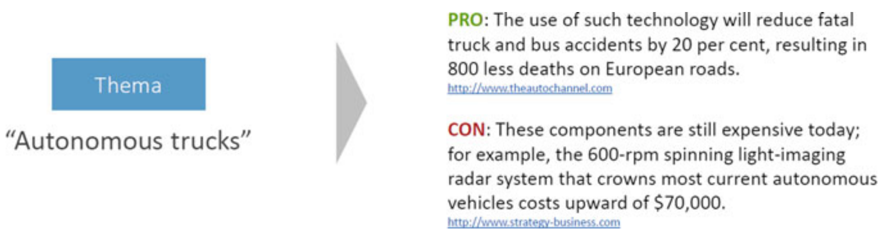

Fig. 4.12 Example of an argument for *ArgumenText*. *Source* Stab and Daxenberger (2018, pp. 3)

- **Scalability**
  The quality of the *ArgumenText* program depends on the underlying **training data**. It is not difficult to imagine the effort involved in annotating texts in order to produce the qualified training data that is absolutely necessary (cf. Sect. 1.3.1 on “annotation”).
  As part of the development of *ArgumenText*, **crowd sourcing** is used, e.g. through the *Amazon Mechanical Turk* platform. This is a crowd sourcing Internet marketplace. In such a marketplace, individuals and businesses can use human intelligence to accomplish tasks that computers cannot perform today. Here, it was the mentioned analysis of texts. Large amounts of text could be quickly annotated through the use of crowd sourcing. Thus, the *Technical University of Darmstadt* succeeded in annotating 40 different topics within a few days.
- **Generalizability**
  An already mentioned important limitation of AI applications is still the lack of or limited generalizability (keyword **Artificial General Intelligence**). Algorithms that have been developed to analyse text for specific domains (e.g. the automotive industry or the fashion industry) cannot simply be used for analyses in other fields (e.g. cosmetics or plants). For humans one would say this is an island talent—or colloquially an expert idiot!

All in all, the use of *ArgumenText* has shown that 85% of human accuracy is already achieved today through AI-supported text evaluation. An example of an analysis for the key term “Artificial Intelligence” is presented in Fig. 4.13).

ArgumenText can find its future use in the addressed **sentiment analysis** to differentiate between positive and negative customer comments. These findings can be incorporated into the **preparation of communication campaigns**. Brand

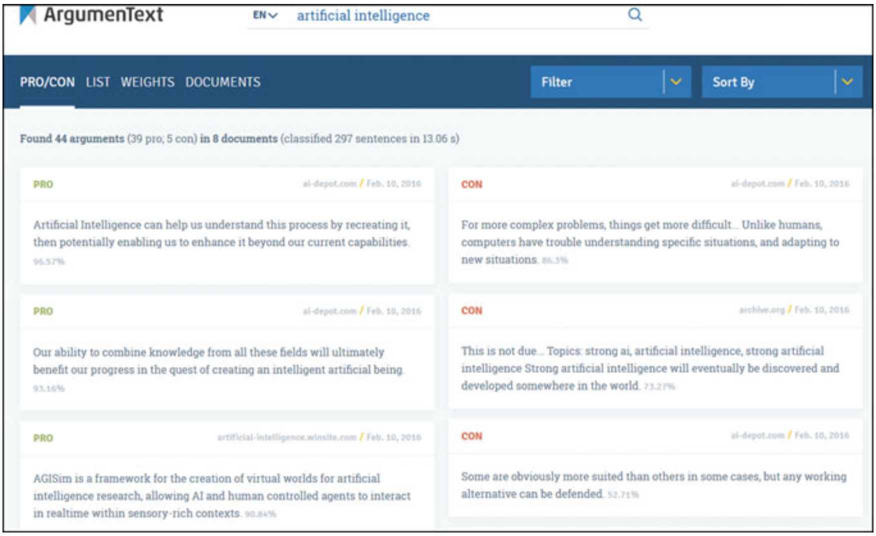

Fig. 4.13 Use case of *ArgumenText*. *Source* argumentsearch.com

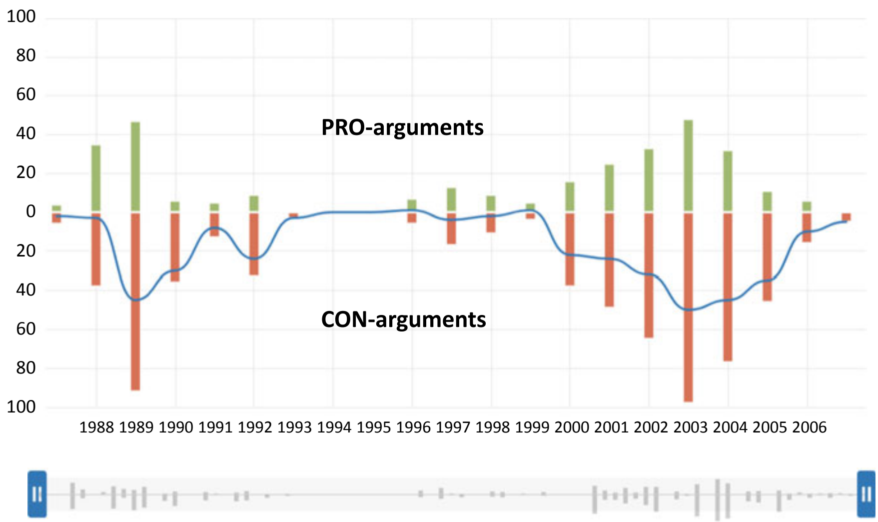

Fig. 4.14 *Trend analysis* concerning "animal testing" using *ArgumenText*. *Source* Stab and Daxenberger (2018, pp. 14)

tracking is also possible to detect mood swings. In this way, trends in valuation and reasons for mood swings can be identified (cf. Fig. 4.14).

With *Sensei*, *Adobe* also offers an AI tool that recognizes the **mood in texts** or the **aesthetic features of images** from large amounts of content. Information prepared in this way can then be quickly processed. The **content AI service** allows images to be selected and edited for reuse (cf. Adobe, 2019).

The German online mail-order company *Otto* has integrated a self-developed **feature for product evaluations** into its online shop. Customers are supported in filtering out the **most important aspects from the reviews** on *otto.de* in order to facilitate access to third-party reviews. The AI algorithm recognizes the most common aspects of the reviews and identifies their tonality at the same time. The presented evaluation information depends on their relevance for the questions of potential buyers:

- What is the appropriate size of a sneaker for me?
- How good does the material feel?
- How is wearing comfort evaluated?

The AI algorithm filters and groups the relevant contributions in order to find the relevant reviews for individually relevant statements, even for many hundreds or thousands of reviews, and displays them as main topics for the product. Customers can orient their search to these topics. These **aggregated reviews** are available for more than 2.1 million products on *otto.de*. This makes it easier to search for "functionality", "recordings" and "battery" for cameras and for "fit" and "style" for

suits. In addition, it becomes visible how many users have expressed themselves positively, negatively or neutrally. To be up-to-date here, the algorithm is fed with product reviews every night to automatically determine important aspects (cf. Otto, 2017).

4.2.4 Dynamic Pricing

AI algorithms are also increasingly being used for **dynamic pricing**. One of the most important factors influencing the profitability of a company continues to be pricing (cf. Simon, 2013). It is therefore not surprising that AI applications have also entered this domain of marketing and sales. Wise Athena (2019) is an intelligent AI agent that supports providers of consumer-packaged goods in defining price decisions and dealer promotions.

In order to achieve this, *Wise Athena* automatically selects the data notes that best describe the behavior of its products in relation to each other. For this purpose, a model is calculated which also takes into account cannibalization effects in the company's own product range and the cross-price elasticity of the company's products. The cross-price elasticity (of demand) determines the percentage change in the quantity of a good in demand that occurs as a result of a one percent change in the price of another good. In contrast to price elasticity, it is important that cross-price elasticity is between two different goods.

Through regular training, the accuracy of sales forecasts could be increased by up to 94% in individual cases. Despite an extremely large number of possible price combinations, the AI system can determine the price combination that optimizes sales or margins. Such an optimized pricing strategy allowed *Wise Athena* users to increase their margins between 3 and 12% per year (cf. Durah, 2018).

An AI-based pricing raises an exciting question: Can it happen that **price-setting algorithms** that take into account all relevant competitor prices (possibly also determined by AI systems), customer demand behavior and other context variables in their decisions result in **AI-driven price agreements** that would be equivalent in effect to a cartel? As a result, as in a cartel, the companies' profits would increase, and customers would pay a higher price than before for the same services. Consequently, **collusive behavior** would occur. The term collusion means "secret agreement" and describes an unauthorized cooperation of several participants to the detriment of third parties.

A further question is: Can such AI-driven price agreements come about even if the algorithms used were not geared to such a procedure? Would the algorithms develop independently—oriented towards the goal of entrepreneurial profit optimization—in such a way that collusive behavior inevitably occurs? Who would be guilty in this case under the *Act against Restraints of Competition*? The original programmer or an AI system that cannot be guilty in the legal sense? These questions are raised by the Control Commission (2018) in its report "Algorithms and Collusion". At the same time, a recommendation is made on how to deal with these developments. The **Monopolies Commission** recommends strengthening

market observation by means of sector inquiries by the antitrust authorities. Information about collusively inflated prices is first sent to the consumer protection associations. For this reason, it is recommended that these associations be granted the right to initiate the conduct of antitrust sector inquiries. If there are concrete indications of the use of price algorithms for collusive behavior, further steps could be decided (cf. Monopolies Commission, 2019).

Scientists regard the **risk of collusive behavior** by AI systems as low. The reasons for this are that the environment changes dynamically because new players enter the market, new rules of the game are introduced, actors pursue different goals (in addition to optimizing profits, e.g. winning new customers, defending against competitors), so that the algorithms may no longer suit a new situation. Consequently, it would be difficult to achieve a stable balance for all actors. For this reason, **algorithmic cartels** are not foreseeable at the moment (cf. further leading Hennes & Schwalbe, 2018, pp. 18).

Food for Thought

Unfortunately, if **algorithmic cartels** were indeed to emerge, the leniency program used today to uncover cartels would not apply. Unless we succeed in conveying values to the algorithms so that algorithms show themselves when a collusive behavior occurs—and then need to avoid it!

4.2.5 Content Creation

Content creation is another important AI field of application in corporate communication. This is the **automated creation of texts**. Artificial Intelligence penetrates under the term **robot journalism** the areas that have been served by journalists so far. Special AI algorithms are able to write independent contributions based on the digital information available on the Internet or elsewhere. Already today, reports about sports events or the weather can be generated automatically. This also applies to short news from the financial world (e.g. a report on the development of stock market prices). Information graphics and tables for such texts can also be created automatically. Here, the recipient can usually no longer recognize that these messages were created automatically. In other cases, Artificial Intelligence supports the work of journalists by providing them with qualified information searches and processing, without completely replacing these tasks. The advantage of (partial) automation lies in its speed (real-time information) and the cost-effectiveness of the corresponding systems.

The New York-based **news and press agency** *The Associated Press* (AP) uses speech recognition to automatically convert large amounts of raw data into publishable reports. These raw data come from the listed companies, which publish their company results quarterly. The challenge for *AP* is to use this data as quickly and accurately as possible to determine the relevant financial figures in order to create informative reports for investors based on them. In the past, two challenges had to be mastered: *AP* was only able to produce 300 such reports per quarter due to

limited human resources. Many thousands of potentially equally exciting stories therefore remained unwritten. In addition, the production of such routine reports tied up a lot of important time for reporters, which was not usable for more demanding tasks (cf. Automated Insights, 2019).

To accomplish this, *Associated Press* uses the *Wordsmith Platform* from *Automated Insights* to automate these processes. The platform uses speech recognition to automatically convert raw data into publishable *AP* stories. For this purpose, the **language generation engine** was configured to write in *AP* style. Today, *AP* can generate 4,400 quarterly financial reports—instead of 300 manually generated reports as before. It is important to ensure that these reports are as accurate as readers would expect from any article written by *AP*. Apart from an explanation at the end of the story, there is no evidence that they were written by an algorithm (cf. Automated Insights, 2019).

After an extensive testing process, it was determined that the probability of errors in automated creation was even reduced compared to manual development. In total, approx. 20% of the time for the preparation of profit reports per quarter could be saved. There are plans to extend **robotic journalism** to other areas, such as sports reporting or reports on the development of unemployment figures (cf. Automated Insights, 2019).

Such developments will not only have an impact on journalists' fields of work, but also on all those who generate "content" for the most diverse channels or are responsible for **content marketing**. Due to the increasing release of content marketing, the need for storytelling is continuously increasing for most companies (cf. on content marketing Kreutzer & Land, 2017, pp. 157–190; Hilker, 2017). This will show whether AI-supported systems can only process data and facts in a user-oriented way (as is the case with financial reports and sports reporting), or whether they can also—more or less independently—tell exciting stories that captivate readers and contribute to the development of companies' skills.

In order to prevent the increasing oversaturation of users with content (keyword **content shock**), it is increasingly necessary to prepare content in a target group or even target person oriented way. An almost inexhaustible source of information that can be used to generate content is the freely available information that people provide about themselves (e.g. via social media). Retargeting in online marketing and individualized recommendations (e.g. at *Amazo*n) are the first "simple" precursors for this, which act with some statistics but still largely without Artificial Intelligence. The **great leaps in the development of content generation** are still to come.

The company *Acrolinx*, a spin-off of the German Research Center for Artificial Intelligence (DFKI), makes an interesting **contribution to supporting the creation of human content**. The company operates a SaaS platform to optimize the creation of written content. For this purpose, *Acrolinx* uses an AI engine that analyses language for style, tone and word usage, including brand terms and technical terminology, in several languages against the background of company-specific goals. Most companies address different target groups that have specific information needs. This must be taken into account in communication without neglecting

brand values. In addition, it is important to provide the "right" information for the customer journey at the relevant contact points (cf. Acrolinx, 2019).

To achieve these goals, *Acrolinx* offers two options. On the one hand, **real-time instructions** can be given to authors during the writing process in order to make the content clearer and more consistent for the respective target group. On the other hand, an **AI-supported assessment of content** can be carried out on the basis of predefined objectives. This enables problematic content to be quickly and reliably identified—in the entirety of corporate communication. *Acrolinx* provides a sophisticated analytics component that enables companies to evaluate their data according to content type and target group within a specific timeframe. Some companies correlate the results of these analyses with performance data to determine which content has worked well and how well (cf. Fig. 4.15; Acrolinx, 2019).

A further challenge for content marketing is to make automatically generated content available in the channels that are relevant for users. Today, these are **messenger platforms** such as *Facebook Messenger, Snapchat, WhatsApp* and *WeChat*. In many cases, users no longer move in public digital space, but in more or less closed user groups. In order to find acceptance and hearing there, the contents must be played out even more individually in order to achieve "admission" through relevance. Therefore, in addition to **AI-supported content creation**, an **AI-supported content distribution** is also used so that the—hopefully—exciting content actually reaches the target persons (cf. Eck, 2018, pp. 164).

An interesting field of work for content creation is the automated **conversion of text into video content**. Here news videos are automatically generated on the basis

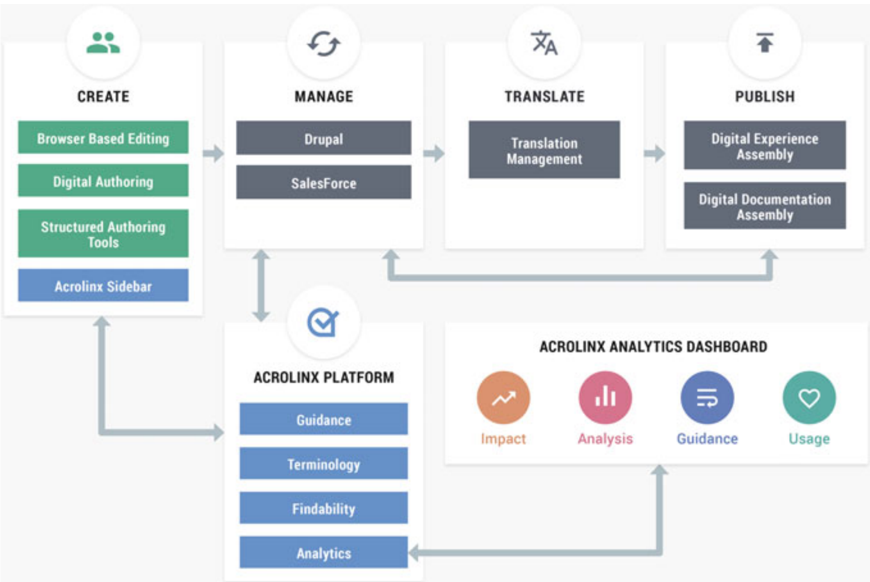

Fig. 4.15 *Acrolinx* platform for content creation. *Source* Acrolinx (2019)

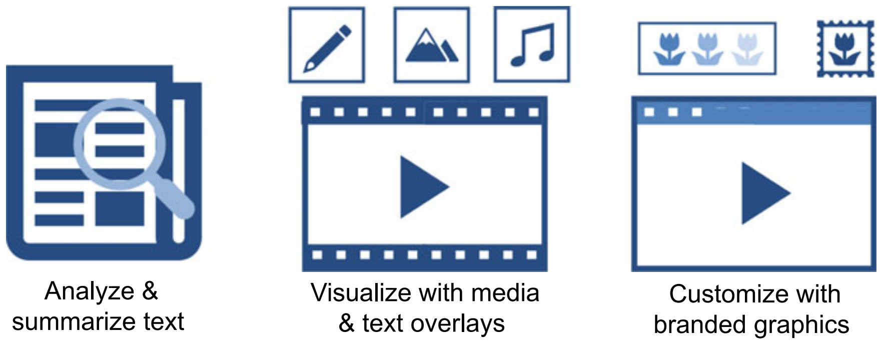

Fig. 4.16 Text-to-video technology. *Source* Adapted from Wibbitz (2019)

of texts. News agencies such as *Bloomberg, NBC, Reuters* and *The Weather Channel* are already using this technology. The integrated service provider Wibbitz (2019, cf. Fig. 4.16) emphasizes strikingly that the generation of video content from text—based on its own solutions—is no longer a witchcraft: "Leverage AI to reduce production resources & maximize video ROI: Our automated text-to-video technology expedites video creation by producing a rough-cut video for your story in a matter of seconds" (Wibbitz, 2019).

An application of video-to-video technology showed *IBM* at the 2018 *Wimbledon Tennis Tournament*, where *IBM Watson* identified the most exciting moments during the games to automatically create a dashboard and highlight videos (cf. Tan, 2018). Such content can then be played out via the various social media channels.

In these areas of content generation and content distribution, the **number of employees is expected to decline** over the next few years as a result of increasing intelligent automation.

4.2.6 Image Recognition

A variety of exciting marketing applications are associated with the face recognition presented in Sect. 1.3.2. Based on the photo of a face, further characteristics can be derived from the person (cf. Fig. 4.17). Especially the age indication (43 years!) made the author feel very flattered when he visited *Sensetime* in Beijing in 2018! After this analysis, the advertising banners for cosmetic products were presented. The corresponding provider was therefore the sponsor of this application.

Another playful **implementation of AI technology** was demonstrated by *Sensetime* in Beijing through the use of funny gimmicks in advertising. Through gesture control, products can be faded into the real image at a suitable point during development for McDonald's—in real-time. There are no limits to other **fun applications**. Thus, in Fig. 4.18 (left), hearts can be dynamically generated by gesture control, while in Fig. 4.18 (right) one can make a fool of oneself. This is the

Fig. 4.17 Face recognition leads to further data (Authors' own figure)

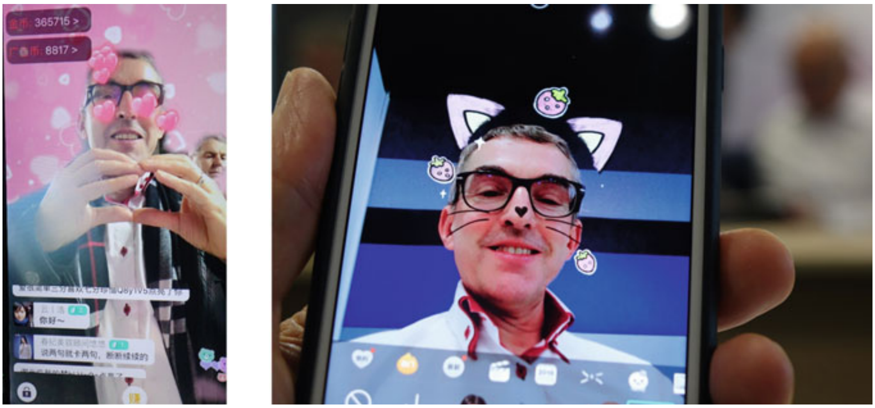

Fig. 4.18 With gesture control to the heart—and other funny applications. (Authors' own figure)

content that users of *Snapchat* & Co. can be enthusiastic about. Such seemingly absurd applications should not be underestimated in their scope. They are precisely these playful pastimes that give the generation of digital natives access to an all-encompassing digital life with Artificial Intelligence—often without this being noticed. Many decision-makers in business and politics have grown up without digital points of contact. In doing so, they run the risk of making decisions that

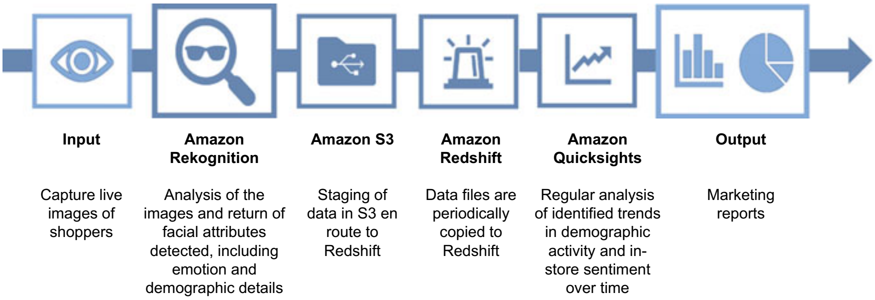

Fig. 4.19 Emotional analysis for retail. *Source* Adapted from Amazon (2019)

ignore the reality of new consumer groups. Therefore, a playful discussion with such applications is not only entertaining, but also instructive!

Memory Box
By different fun applications barriers against Artificial Intelligence can be dismantled. You should check whether this could be an interesting field of activity for your company.

Amazon (2019) offers *Amazon Rekognition*, a **platform for image and video analysis** for interested users. To use this platform, only an image or video needs to be prepared for the *Recognition* API (interface for application programmers). For this purpose, this content must be stored in *Amazon S3, Amazon*'s cloud computing web service. Then objects, persons, texts, scenes and/or activities can be recognized.

Amazon Rekognition can also be used for **facial analysis** and **face recognition** on images and videos. This allows faces to be recognized, analysed and compared for a wide variety of applications. The spectrum of uses ranges from user verification up to counting people in public spaces in order to take into account the capacity limits of squares and event rooms. In order to use the functionalities of *Amazon Rekognition*, the provided recognition API must be integrated into the respective application. This does not require any specialist knowledge of machine learning. Like other AI systems, the image recognition used is continuously trained with new data in order to increase the ability to recognize objects (e.g. bicycles, telephones, cars, buildings), scenes (e.g. parking lots, beach, shopping malls, cities) and activities (e.g. "parcel delivery" or "football match" for videos). In addition, the respective recognition accuracy is to be improved. Depending on the volume, *Amazon Rekognition* offers batch and real-time analysis. Payment for these services is based on the number of images analysed or on the length of the videos as well as on the size of the own repository provided for image recognition, i.e. a directory with facial images (cf. Amazon, 2019).

In addition, *Amazon Rekognition* also offers the already described **facial analysis** options. This allows you to determine characteristics such as mood, age,

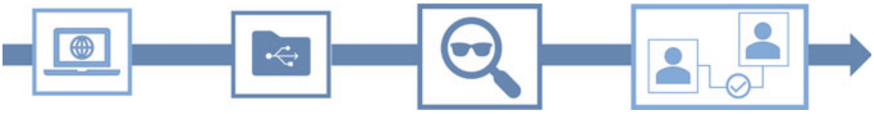

Fig. 4.20 People search in social media. *Source* Adapted from Amazon (2019)

open/closed eyes, glasses, beards, etc. in uploaded images and videos. For videos, you can also capture how these properties change over time. Feelings such as happiness, sadness or surprise can also be recognized in facial images. Of particular interest is the possibility of analyzing live images (e.g. from shops) and determining the dominant emotional attributes (cf. Fig. 4.19). These can be sent continuously to the respective branch locations (cf. Amazon, 2019).

Videos can also be used to **determine movements** in order to analyse running patterns in shopping malls or moves after a football match. Another interesting feature is the **identification of unsafe content**. *Amazon Rekognition* can identify potentially unsafe and inappropriate content in image and video assets. Using labels to be individually defined, it can then be defined which contents are to be permitted and which are not.

A special kind of identification is the **recognition of personalities**. The system can be used to identify known persons in video and image libraries. The contributions identified in this way can be used for specific marketing applications. It is also possible to recognize text in images. These include street and town names, inscriptions, product names and number plates (cf. Amazon, 2019).

Amazon Rekognition Video can be used to create applications that help **locate wanted people in video content** in social media. Faces can be compared with a database of missing or wanted persons provided by the user in order to accelerate rescue or search actions by positive recognition (cf. Fig. 4.20; Amazon, 2019).

Memory Box
For the sake of completeness, it should be noted that for all these facial recognition applications, the relevant data protection laws of the respective countries must be taken into account.

4.2.7 Fake Detection

Fake detection is an important field of Artificial Intelligence. This is essentially a matter of identifying false reports of correct messages in the various online sources. In the development of such AI algorithms, the acquisition of training data often poses the greatest challenge. After all, information about which messages are "correct" and which are "wrong" must be available—and this in the face of an

infinitely comprehensive flood of information that constantly generates new content. This can lead to content that was wrong yesterday being correct today all of a sudden. “Wrong” can occur in several ways:

- Contributions can be blatantly **incorrect** in the sense of being untruthful.
- Contributions can represent a correct result, but make (some) **wrong interpretations**.
- Contributions can disguise themselves “**pseudo scientifically**”, i.e. establish a scientific reference that is de facto not given (e.g. in a non-representative survey).
- Contributions can be as **news disguised opinions, offer and/or company recommendations**.
- Contributions may be falsified because there is a **pro-domo effect** (for explanation cf. Sect. 2.4).
- Contributions can express **ironically or sarcastically** the opposite of what is actually meant.
- Contributions may contain **quotations from other sources** with which the author agrees—or disagrees.
- Contributions can be **distorted out of context** and thus convey a completely different content than originally meant by the sender.

Food for Thought

Developments in the US election campaign and the Brexit vote have just shown how significant is the discovery of tendentious and/or false news. Current observations of how individual groups strive for the targeted disinformation of broad sections of the population and thus the weakening of Western democracies also underline the relevance of this important area.

The fact that the human eye is still indispensable in these challenges is shown by the new hires on *Facebook, Google* and Co. In service centers, the relevant employees have the task of checking content that cannot be clearly evaluated before it is blocked or released.

One of the tasks to be mastered here is the **identification of fake accounts** that have established themselves in the social media. Such fake accounts are also called **sock puppet**. This term is based on a ventriloquist with a hand-puppet, who also pretends to be someone else. Fake accounts refer to (additional) user accounts with which different goals are aimed at. The use to protect one’s own privacy is legitimate. But they can also be used to represent opinions within a community with several voices—in order to distort the sentiment. Fake accounts are also used to undermine the rules of a community and deliberately provoke or disrupt dialogs.

Meanwhile it is regularly reported that *Facebook* or *Twitter* have again identified and closed hundreds of such fake accounts. It can be assumed that at the same time new fake accounts will be opened to a similar extent from the so-called **troll factories**. In an online environment, a **troll** is a person who, through his or her communication, above all wants to emotionally provoke other discussion

participants, hinder communication on the Internet in a destructive way and/or disseminate tendentious contributions. Apart from the social networks, these trolls are particularly active in discussion groups, blogs and chat rooms. These propagandists also try to place their "contributions" in wikis in order to manipulate public perception and opinion. Here, reviews of videos and other contributions in social media are falsified. At the same time, attempts are being made to give their own posts greater visibility. For this purpose, people or chatbots can be encouraged to comment on or share specific posts. In this way, the supposed popularity of a message can be dramatically falsified.

It is no trivial undertaking on the part of platform operators to identify and exclude these black sheep. If the criteria are set too "sharp", accounts of "uninvolved" are also closed—possibly because they have repeated false reports to draw attention to the problem. If the criteria are too "blurred", many "black sheep" remain unrecognized. Artificial Intelligence can make a significant contribution to recognizing patterns that point to manipulative bots and posts. Corresponding triggers can be the timing and frequency of posts, the focus on a specific target audience, the dominant content and its tonality.

Food for Thought

As Artificial Intelligence advances in the identification of fake news, its use to generate fake news will also be improved.

The early **detection of false information** can be relevant for very different areas of a company. First of all, one should think of the marketing area, which should quickly recognize tendentious (false) representations. Risk management, research and development, sales and even human resources can also benefit from early detection. Companies are attacked in the following ways, which are not free of overlaps (cf. Grothe, 2018, pp. 207, 211):

- **Dissemination of reputation-damaging content** via the company, its representatives and/or its offerings
- Dissuading potential customers by **misinforming them about the quality of products and/or services**
- Impairment of the employer's image due to **false reviews by employees** who have never worked there.

The collection and in particular a consolidated evaluation and interpretation of the information obtained in this way represents a great challenge for the companies. You should check whether the installation of a **newsroom concept** is a good solution for your company (cf. Fig. 4.21). This is a concept in which—analogous to the procedure in the editorial offices of newspapers and TV/radio stations—all current news about offers, brands, strategies and the company in general converge at a central point in order to be able to react quickly and consistently. At this location, the contents of the communication in the social media, from the customer service center together with the findings of web monitoring can be combined and

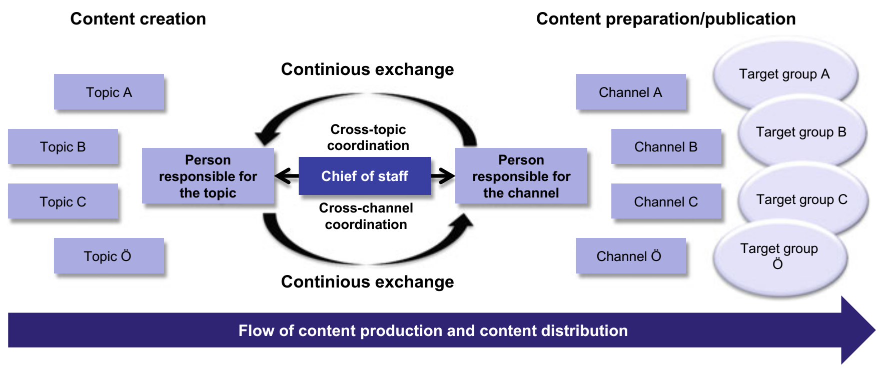

Fig. 4.21 Newsroom concept. *Source* Adapted from Lauth (2016)

analysed in connection with the other challenges of the market. Afterwards, it is also necessary to proactively define central topics and coordinate the channels and concrete content relevant to their processing throughout the company. This ensures the **360° view of the markets**, which is often demanded.

The overall **effects** that can be achieved **in marketing and sales** through the use of Artificial Intelligence in the coming years are shown below. These results are based on McKinsey's already cited analysis of more than 400 AI-related use cases in different companies (cf. McKinsey, 2018, pp. 21). The following values give an impression of the additional value that can be achieved in various areas of marketing and sales:

- **Customer service management**: US-$ 400–800 billion
- **Next-product-to-buy** (individualized purchase recommendations): US-$ 300–500 billion
- **Price and promotion campaigns**: US-$ 300–500 billion
- **Acquisition of prospects and customers**: US-$ 100–300 billion
- **Dismissal prevention**: US-$ 100–200 billion
- **Channel management**: US-$ 100–200 billion
- **Product development/product development** cycles: US-$ 200 billion.

Even before supply chain management and production, these are the **highest value creation potentials** determined in the course of the analysis. It is not necessary to trust the individual figures in detail. It is important that you recognize the potential for using AI in marketing and sales in order to go for your own AI journey (cf. Sect. 10.3).

Summary

- **Lead prediction and lead profiling** is an important field of application for Artificial Intelligence in order to make customer acquisition more economical.

- This includes the identification of **look-alike audiences** in the acquisition of new customers.
- The quality of **predictive analytics** can be improved based on the AI-based findings.
- The development of **individualized recommendations** (keyword **recommendation engine**) can contribute to increasing customer values.
- **Media planning** can be supported or implemented by AI platforms.
- The AI-based evaluation of important environmental information makes **context marketing** possible.
- AI applications support the development of **conversational commerce**.
- The trend to be considered in the long term is no longer **voice first**, but **voice only**!
- AI systems can support **web and social media monitoring** by analyzing the tonality of contributions through **sentiment analyses**.
- The implementation of **dynamic pricing** can be controlled by AI processes.
- Both content **creation and content distribution** are already handled by AI systems.
- **Image and video evaluation** open up a number of interesting application possibilities.
- The **detection of fake accounts and fake news** poses a great challenge for AI processes.
- The **newsroom concept** represents a possibility for holistic processing and control of company-related data streams.

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Fields of Application of Artificial Intelligence—Retail, Service and Maintenance Sector

5

Abstract

In this chapter you will learn that an AI-related analysis of the entire value chain in the retail sector is worthwhile in order to identify the potential of AI applications. Virtual agents will become helpful partners in stationary retail. We will also analyse how anticipatory shipping, interactive screens and table tops, as well as autonomous shopping cart will change the retail landscape. AI also offers many possibilities to forecast purchasing behavior. The concept of predictive maintenance can be used to develop new business models based on usage rather than ownership. The idea of predictive maintenance can intensify the customer-supplier relationship in the consumer market and can lead to predictive servicing.

5.1 Challenges in the Retail Value Chain

An **AI-related analysis of the value chain** reveals that the greatest short- and medium-term opportunities in retail are associated with **promotion management**, **assortment design**, **procurement and logistics**. Well-founded prognoses not only help with procurement management but can also support the development of successful promotions as well as the target group—optimized assortment. The following **developments in retail** will challenge us in the coming years (cf. McKinsey, 2017, pp. 42, 45; continuing Gläß, 2018):

- The use of facial recognition software and the control of natural speech by AI systems will lead to an increased use of **virtual personal agents** (cf. Sects. 4.1.3 and 4.2.2). They will welcome us personally in stationary shops and not only accept orders but anticipate them. In addition, they can give (unsolicited)

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instructions for the successful completion of the purchase as well as for the further use of the purchased items.

- AI applications also support the **use of promotions** in retail. An interesting application is available from SO1 (2019). This company promises its customers to develop more effective promotional campaigns. The guiding idea here is to individualize promotions much more strongly, driven by data. To achieve this, *SO1* supports various communication channels and can be integrated into existing systems, tools and processes.
  The AI application developed by *SO1* is intended to create an **individualized promotion experience** via an autonomous and self-learning promotion channel. Three fields of application will be presented: **smart recommendations**, **optimized discounts and programmatic brand promotions**. *SO1* offers a software as a service solution for food retailers and drugstores. Based on the incoming data, the AI application can predict with high accuracy if and what customers would choose without personalized offers, which offers would increase the shopping basket and which discount amount would trigger which additional purchases. The preferences of consumers for categories or products that they have never bought can also be determined. Major food and drugstore retailers in the US and Germany have already used the *SO1* solution to increase sales and profits. For this, *S01* uses the software *Microsoft Azure* described in Sect. 10.2 (cf. SO1, 2019).
- *Amazon* relies on **anticipatory shipping**, which attempts to fully anticipate customer orders and dispatch goods without having already made a purchase. Previously, the products of the anticipated order were delivered to distribution warehouses close to potential customers in order to be able to deliver the actual order within the shortest possible time. In future, delivery will be made directly to the potential customer—together with the notice:

> "We know that you are considering buying this product. Because we're sure it's right for you, we already sent it to you today."

It is up to us whether we see this as a **perfect service** or rather as an **expression of big brother surveillance** that teaches us to fear.

- **Interactive screens and table tops** can identify products selected by the customer and—based on AI algorithms—**recommend suitable additional products and services**. These recommendations are not only based on previous purchasing behavior but can also take into account the purchasing power and lifestyle of each individual customer if a—permission-based—link can be established to such data.
- An **autonomous shopping cart** supports the purchasing process in stationary shops. This purchasing aid will also find its way to our vehicle—or hand over the goods to a robot or drone for home delivery.
- AI applications can be used to play out **individualized advertising** campaigns that are oriented towards the individual customer profile. In-store beacons allow the customers in the shop to receive tailor-made offers (cf. Fig. 5.1).

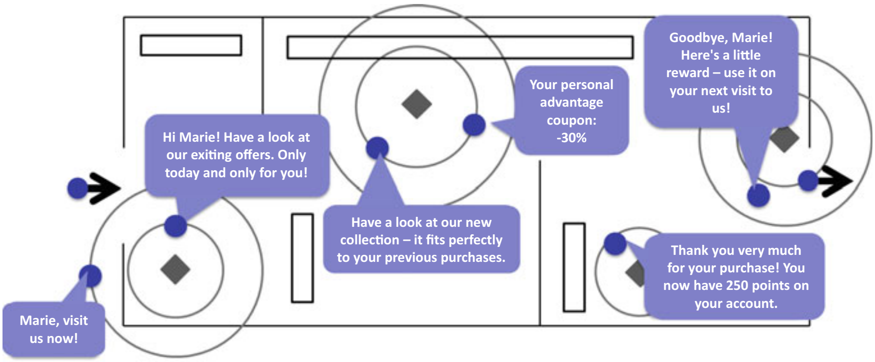

Fig. 5.1 Possible applications of in-store beacon technology (Authors' own figure)

- We will also be able to gain a **cashless shopping experience**. For this purpose, the articles selected by the customer in the shop are identified via image recognition. A large number of sensors determine which products have landed in the shopping chart and which have been put back again. Combined with a direct access to a digital account of the customer for **automatic payment** the customer can leave the store without stopping at checkout. Such businesses are already reality under the name *Amazon Go*.
- In the stores, **shelf prices can be updated in real-time** and thus implement the dynamic pricing described above (cf. Sect. 4.2.4). For this purpose, data on the prices of alternative suppliers, the current weather situation and/or the stock levels of competitors are used in order to optimize the profits. It remains to be seen how customers will react if price comparisons—even in stationary retail—are made impossible due to dynamic pricing and learned prices lose relevance. An additional challenge is to get access to the big data streams!
- An **AI-based shelf monitoring** system identifies the stock being picked and can assign robots to load before the shelf is emptied. Here, an anticipating shelf refilling is used—oriented to learnt sales rhythms.
- After all, **autonomous drones** will take over the delivery on the last mile—at the times that the respective buyer wants or that AI algorithms have determined to be "optimal".
- In e-commerce, **digital object recognition** leads to interesting customer advantages. AI systems can recognize products on photos in which the user is interested. The *Zalando App* offers a corresponding solution. Here it says in the app: "Photo search—With the photo search you can photograph great street styles and search for products in similar colors and patterns. The photos you select will be used by Zalando exclusively for photo search and will not be stored beyond that" (Zalando, 2019).

  As soon as a corresponding photo has been taken, the *Zalando* online shop will be searched for comparable products. Before the user must agree to "access photos": "Please allow Zalando access to your photos. So you can select photos

from your library and save them under 'Recordings'" (Zalando, 2019). However, this means that *Zalando* has access to the entire photo stock of the corresponding device. Shooting a single photo and performing the analysis does not work (as of May 2019). In addition, the barcode of a garment can also be scanned, if it is still available—and the current wearer of the garment has nothing against it!!!

Food for Thought
The big question is whether Artificial Intelligence can help traditional, non-digital retailers regain the terrain lost to digital players—or whether the gap between the two groups is widening. The answer also depends on who has more data, the more powerful algorithms and the more qualified personnel—supported by the corresponding budgets. There is not much imagination needed to come to the conclusion that especially smaller, traditional retailers will find it difficult to win this AI race or to compete in this race at all.

5.2 Forecasting Purchasing Behavior in the Retail Sector

Image recognition can provide retailers with additional information for **forecasting purchasing behavior**. Anyone who "adorns" themselves on the photos uploaded to *Facebook* with *Prada* or *Gucci* bags (fake or real?), poses in front of luxury vehicles, posts from exquisite shopping malls or 5-star hotels says something about the—aspired or practiced—lifestyle and brand affinities. It may even be possible to classify the garments worn according to brand, price level and size and assign them to specific clothing styles. The data basket continues to fill, which *Facebook* manages through us.

The analysis doesn't stop here. In a study, *Facebook* divided 160,000 US-users into "**dog people**" and "**cat people**" on the basis of the uploaded photos—as a starting point for further analyses. An important starting point was the assumption that dogs act generally more socially and calmly, while cats are reserved, independent and unpredictable. There is the beautiful statement: **Dogs have owners, cats have staff.** The question now was whether the "animal" characteristics are reflected in the behavior of the respective owners. The relevant questions were as follows:

- Who has more friends?
- Who is more likely single?
- Which television programs are preferred?

The following differences could be observed between the two cohorts (groups):

- In general, it has been shown that the prejudices are correct!
- Dog people are more open-minded—measured by the number of their *Facebook* friends. On average, they have 26 more *Facebook* friends than cat people.

- Like their extroverted pets, dog people also make more connections online.
- Cat people are invited to more events.
- Cat people tend to be friends with other cat people; analog dog people tend to be friends with dog people.
- Cat people in particular are 2.2 times more likely to be friends with other cat people than randomly selected friends from the general population.
- Dog people “only” make friends with other dog people 1.8 times as randomly selected friends.
- Cat people are more single (30%) than dog people (24%)—based on the status of the specified profile relationship. Maybe the additional 26 friends mentioned above helped the dog people to find a partner!
- Cat people prefer more indoor activities: they like over proportionally more books, TV and movies (measured by *Facebook* likes).
- As shown below, there are differences in preferences for certain books. Books that cat people like over proportionally are *Dracula* and *World War Z*. Books preferred by dog people are e.g. *Marley and Me*. Similar preference differences were also found for television programs and films.

While **cat people** go almost 1.5 times more often for books like (cf. Adamic et al., 2016):

- *Dracula* followed by (in decreasing order)
- *Watchmen*
- *Alice in Wonderland*
- *World war Z*
- *1984*
- *The Hobbit*
- *Stephen King books*
- *Brave New World*
- *Harry Potter and the Deathly Hallows*
- *Van Gogh: The Life*.

Dog people definitely prefer more than 2.5 times more the dog comedy (cf. Adamic et al., 2016):

- *Marley & Me* (the following books show a about 1.25 timeshigher preference in decreasing order)
- *Lessons from Rocky*
- *The Purpose Driven Life*
- *The Shack, Dear John*
- *The Help*
- *The Notebook*
- *Eat, Pray, Love*
- *The Last Song*
- *Water for Elephants*.

The following books are rather neutral between dog and cat people (cf. Adamic, Burke, Herdagdelen, & Neumann, 2016):

- *Catcher in the Rye*
- *The Giving Tree*
- *Laws of Power*
- *The Lost Symbol*
- *The Great Gatsby*
- *Hunger Games*
- *Atlas Shrugged*
- *I am Legend*
- *The Art of War*
- *Pride and Prejudice*.

Sentiment preferences can also be derived from *Facebook*'s mood function (status updates can be commented with moods like "be excited" or "be blue"). Cat people post more than average that they feel tired, but also happy and loved. Cat people express a greater variety of feelings on the page. Dog people tend to communicate excitement or pride. In detail, the following feelings with decreasing order are more likely to be found in cat people (cf. Adamic et al., 2016):

- Tired (about 1.2 times)
- Amused
- Annoyed
- Happy
- Sad
- Loved
- Emotionally
- Thankful.

No side could be assigned to heartbroken unambiguously. Dog people, on the other hand, have the following feelings in decreasing order (cf. Adamic et al., 2016):

- Exited (about 1.2 times)
- Proud
- Blessed.

Memory Box
Whether we do something or not, whether we own something or not, whether we travel or stay at home, whether we travel alone or with others: When we share it with *Facebook* through posts, photos and videos, *Facebook* learns a lot more about us than we think (and should know)!

Artificial Intelligence enables the **intelligent acquisition and processing of raw data**, **powerful pattern recognition** and the **derivation of convincing calls-to-action**. These lead to reactions and non-reactions of the users. Both are in turn actions that are recorded, processed, recognized and implemented in measures that lead to reactions and non-reactions, which trigger new calls-to-actions, which…

5.3 Service and Maintenance Sector

Artificial Intelligence has already achieved extensive use in **predictive maintenance**. Plants and machines should not be serviced only if they fail or errors occur, but by a proactive approach already before (cf. Chap. 3). For this purpose, sensors record measurement and production data of components, machines and entire plants during the running process. From this information, AI algorithms can derive **maintenance and replacement requirements** and **predict possible faults**. A repair or replacement of wearing parts should therefore take place at a time when the units are still running correctly. This can reduce downtimes and optimize the fields "simplify" and "automate" described in the expectation matrix of customers and companies (cf. Fig. 4.1).

The predictive maintenance approach differs significantly from the **maintenance logic** of aggregates, which still dominates today. Until now, maintenance has been based on time periods and/or machine running times, as is the case, for example, with regular inspections for passenger cars, busses and trucks. During routine maintenance, parts are often replaced that might have lasted even longer—but replacement specifications "force" an exchange already now!

The following **predictive maintenance steps** are necessary:

- At the beginning there is **the collection, digitalization and consolidation of data** from the most diverse performance components of a car, machine, a plant etc. For this purpose, IoT sensors can be used and maintenance logs can be read out. In addition, reference files can flow in from external sources, e.g. about performances and disturbances of the same or similar systems, which may be in use worldwide. Further, data from the relevant context can be taken into account, such as room temperature, air pressure and humidity of the area in which the machines or systems are used if these are important for maintenance.
- The **analysis and evaluation of the recorded data** is also carried out with the aim of pattern recognition using AI algorithms.
- Based on the identified patterns, it is a matter of **determining probabilities of occurrence for malfunctions, maintenance requirements**, etc.
- Based on the determined probabilities of occurrence, concrete **processes are initiated** and **recommendations for action are derived**. This means that spare parts can be ordered automatically and stored at San Francisco Airport so that they can be installed immediately when the *A380* lands in five hours. Maintenance and cleaning measures are recommended for a passenger elevator so that it

continues to function smoothly. In addition, the service technicians can be supported in their maintenance work by augmented reality systems.

Figure 5.2 shows the **interaction of different internal and external data sources.**

Memory Box
The **core of predictive maintenance** is the **proactive recognition of the need for action for the maintenance, repair etc. of machines and systems**—even before a malfunction has occurred. Relevant data is evaluated in real-time to determine the optimal time of the "intervention". Spare parts etc. required for this can be ordered in good time.

This can reduce downtime and better manage the deployment of service personnel. In addition, the storage of necessary spare parts etc. can be improved. Based on the data obtained, impulses for the further development of machines and plants can be gained in the next step.

Predictive maintenance is already used in many areas today. These include, but are not limited to:

- Monitoring of engines (e.g. for aircrafts, ships, cars)
- Monitoring of wind turbines
- Monitoring of production facilities
- Monitoring of elevators
- Monitoring of pipelines.

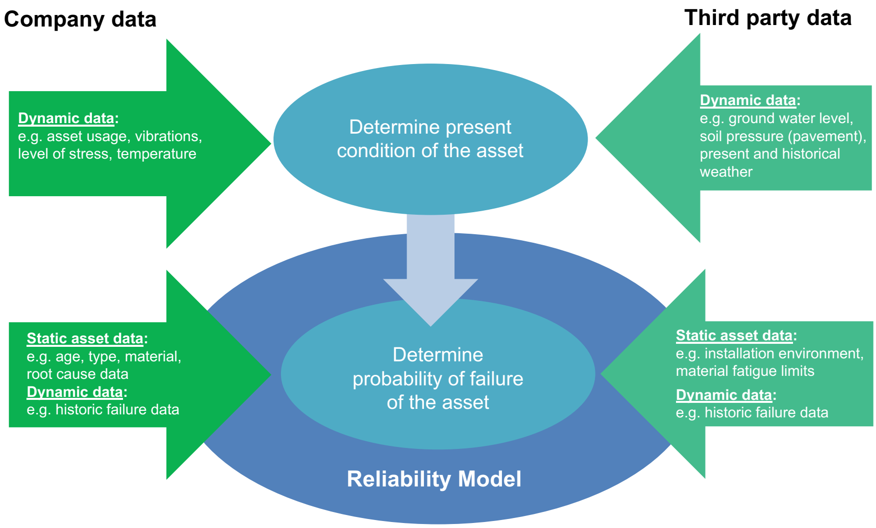

Fig. 5.2 Predictive maintenance model. *Source* Adapted from Hoong, (2013, p. 14)

If sensors detect overheating, uneven running or other deviations from standards during production, signals are automatically sent to the responsible service stations. In the case of aircraft, ships and cars, the service employees already know at the time of landing, when entering the port or when visiting the car workshop what measures need to be taken. Therefore, the necessary spare parts can be procured in advance. When monitoring production facilities, elevators, etc., the sensors also identify potential faults at an early stage, from which maintenance requirements can be derived. These are submitted to the responsible employees as suggestions. The **use of predictive maintenance** is illustrated in Fig. 5.3.

The following **predictive maintenance results** can be achieved (cf. McKinsey, 2017b, pp. 8, 27):

- **Avoidance of downtimes** in production
- **Increase of plant productivity** by up to 20% (based on less downtime)
- **Reduction of maintenance costs** by up to 10%
- **Reduction of monitoring costs** by up to 25%

TÜV NORD has developed an interesting field of application for the monitoring of container and road bridges as well as pipelines. Sensor-based strain gauges are attached at critical points. These can not only measure material elongation, but also surface temperatures. The continuously increasing data flow is transferred into an online monitoring system and examined for anomalies which indicate cracks. In this way, remedial action can be taken even before damage impairing use occurs (cf. Stenkamp, 2018, p. 20f.).

The **concept of predictive maintenance** also makes **new business models** possible. Instead of selling plants or aggregates (such as elevators or turbines), "availability" is sold to customers. The corresponding price concepts are **power-by-the-hour**, **pay-as-you-go** or **pay-per-use**. This often results in much more intensive customer relationships because there is a comprehensive and continuous exchange of information between manufacturer and customer. The

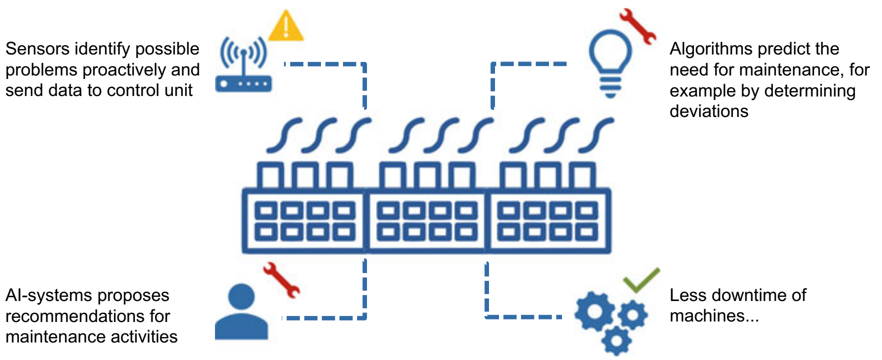

Fig. 5.3 Use of AI to achieve predictive maintenance (Authors' own figure)

responsibility of the company does not stop with the delivery of a product. Rather, this delivery represents the **intersection between a production-dominated and a service-dominated sphere in the manufacturer-customer relationship** (cf. Kreutzer, 2017a, p. 277).

Memory Box
In the McKinsey (cf. 2017b, p. 21) study cited above, it was determined that **predictive maintenance** could generate additional value of US-$ 500–700 billion over the next few years. This should be incentive enough for you to consider the use of predictive maintenance for your business.

The basic idea of predictive maintenance can also be used in the consumer market. **Predictive servicing** should be mentioned here. The basics are created by the **Internet of Things** and thus the ability of everyday objects to receive and send information online. These developments can not only meet the expectations of consumers for increasing simplicity but can also take the wishes of companies into account (cf. Fig. 4.1 on the expectation matrix). As shown below, the retail trade can (partially) fall behind.

A nice example is the ***Nespresso Prodigio Titan*** machine. As the saying goes (Nespresso, 2019): "PRODIGIO is the first Nespresso machine that can communicate directly with your smartphone or tablet via Bluetooth Smart Technology. Enjoy our coffee assortment in a completely new way with the advantages of the Nespresso App. Keep track of your capsule supply, plan the time of your enjoyment moments, start the brewing process by remote control and be reminded of the maintenance of your machine".

Such a **comprehensive service** is made possible by several steps. The machine can communicate and the customers have also provided their data by becoming members of the *Nespresso* Club. The purchasing behavior concerning the coffee pads in different colors can be used at the same time to draw conclusions about the preferences for enjoyment in order to make tailor-made offers.

The *Nespresso* system can use the app to indicate when the capsule supply is running low. For this, the average future consumption, the time for a decision (at the push of a button for reordering is sufficient) as well as the time required for dispatch are taken into account. In the future, this can even be done with foresight—based on predictive analytics. Because my supplier knows that I drink more coffee in winter and prefer the stronger roasts, a supply package can be sent to me—without any action on my part. The basis of this **anticipatory shipping** is the intelligent processing of all these data. Here, it also becomes clear why the term **predictive servicing** (instead of predictive maintenance) is appropriate for this further service.

One important aspect should not be underestimated: If the customer is competently and proactively looked after in this service world, his or her willingness to switch to significantly cheaper capsule suppliers decreases! This significantly increases its customer value for the offering company.

Memory Box
Today, the concept of **predictive servicing** still offers largely untapped growth potential for companies. Open it up for your company!

Summary

- In the retail sector, an **AI-related analysis of the entire value chain** is worthwhile in order to identify the potential of specific AI applications.
- In the future, we will encounter **virtual agents** as helpful “ghosts” in stationary retail.
- With **anticipatory shipping** we will be delighted with deliveries even before we have placed the order.
- With **interactive screens and table tops**, further techniques will be introduced into the trade in order to advise us more comprehensively.
- Perhaps soon, an **autonomous shopping cart** will be managing our supplies in the stationary trade.
- There we will also be increasingly **personalized advertising campaigns**—depending on where we are located in the store (also a variant of context marketing).
- We can already gain **cashless shopping experience** today in selected stores.
- It remains to be seen whether customers will agree to a **dynamic change in prices in stationary stores**.
- **AI-based shelf monitoring** will ideally result in an out-of-stock situation becoming increasingly rare.
- For e-commerce companies, **digital object recognition** offers an interesting opportunity to convert what they have just seen into what they have “ordered immediately”.
- AI offers a lot of possibilities to **forecast purchasing behavior**.
- The concept of **predictive maintenance** has already begun its triumphal march and will continue to spread over the next few years.
- Predictive maintenance can be used to develop **new business models based on usage rather than ownership**.
- The idea of predictive maintenance intensifies the customer-supplier relationship in the consumer market and can lead to **predictive servicing**.

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Fields of Application of Artificial Intelligence—Health Care, Education and Human Resource Management

6

Abstract

In this chapter you will learn a lot about the different fields of application for AI in the healthcare sector. It starts with a comprehensive evaluation of health data to increase the quality of diagnosis. The use of Artificial Intelligence can also lead to a relief of routine tasks in health care—so that doctors and nursing staff can spend more time with patients. Artificial Intelligence can also make a significant contribution to closing the strategic qualification gap in training and further education. In addition to the technical infrastructure, this requires in particular the education of the lecturers themselves; because their knowledge is also becoming outdated faster and faster. A larger field of AI applications is already available in companies through applications of virtual reality and augmented reality. Artificial Intelligence can also provide support in HR management—e.g. in the acquisition of new employees. Online platforms can help to bring together supply and demand here.

6.1 Health Care Applications to Improve Standard Processes

It is to be expected and hoped that the use of Artificial Intelligence in healthcare will improve the attainable quality of life through new medical achievements. A large number of AI applications are already available today. Large AI players in the medical field are currently *Google*, *IBM, Isabel Healthcare, NEC, Nuance, Microsoft, Ipsoft, Rocket Fuel* and *Fingenius*.

Digitalization will initially make it possible to prepare a wide range of **medical data for AI application**. The spectrum here ranges from **patient files** to the—in part already digitally available—**results of examinations** to the **personal health data** generated by wearables and apps (cf. Pinker, 2017; Stanford University, 2016,

R. T. Kreutzer and M. Sirrenberg, *Understanding Artificial Intelligence*, Management for Professionals, https://doi.org/10.1007/978-3-030-25271-7_6

p. 25). Artificial Intelligence can play off many of its advantages in the medical sector:

- Simultaneous access to hundreds of thousands or millions of relevant historical image and text documents (including reviews) for diagnostic purposes
- Real-time access to new insights gained by researchers and/or colleagues in their daily work (including clinical trials)
- Evaluation of the complete medical file of the respective patient, so that the corresponding data is available in a linked form
- AI-supported questioning of the patient to supplement any missing information and/or to test hypotheses
- Derivation of therapy recommendations which are based on a large number of therapy recommendations from third parties and the achieved results.

The **medical fields of application of Artificial Intelligence** can be grouped as follows:

- Diagnostic-supporting applications
- Diagnostic-replacing applications
- Therapy-supporting applications
- Therapy-replacing applications.

There are still many challenges to overcome on the way there. There are problems with the **interpretation of medical notes** by doctors and with the **interdisciplinary transfer of results** (also for reasons of data protection). As long as in countries like Germany a decentralized health care system is dominant and an integrated patient file (with a complete documentation of diagnoses, therapies and therapy successes) is only available as a concept, the evaluation possibilities remain very limited. In addition, as with all AI systems, a **comprehensive and intensive training phase** is required to equip AI applications such as *Watson* with the necessary data (cf. Waters, 2016; Bloomberg, 2017). A consolidated data basis that brings together anonymous medical records from a wide variety of sources is still missing in many countries.

Individual AI applications already exist. *Watson for Oncology*—an AI program for cancer detection—is used today in 230 hospitals to help physicians diagnose and treat cancer. The experience gained with *Watson Health* is incorporated into the AI algorithms for further training (cf. Rossi, 2018, p. 21). The limits of Artificial Intelligence are still evident here. As already mentioned, each AI system must be calibrated for the respective field of application. In the case of health care, it must first learn all the relevant terms and also the type of formulations in doctor's letters and examination findings. How can the statement "… could not be excluded" be evaluated? Is there something or not? In addition, the AI systems must learn the common medical abbreviations. Also, a variety of relevant guidelines and common therapies must be covered. Sometimes *Watson* already fails because of speech recognition! Again, the following applies: The system must still be fed

comprehensively with relevant data and the results need to intensively analyse the data streams until the system approaches or even surpasses that of good doctors in terms of its ability (cf. Müller, 2018a, p. 106f.; Burgess, 2018, p. 32). There is still a long way to go from a diagnostic-supporting to a diagnostic-replacing application.

The so-called ***Camelyon Grand Challenge 2016*** delivered interesting results in this area. This showed that the combination of machines and people lead to the best results. A team of *Harvard* and *MIT* researchers developed a deep learning algorithm for medicine to detect metastatic breast cancer. The pathologist was in direct comparison superior with a correct prediction in 96.6% of the cases of the machine with 92.5%. In a second test, the predictions of pathologists and machines were combined—with a result of 99.5% accuracy (cf. Wang, Khosla, Gargeya, Irshad, & Beck, 2016). This corresponds to an 85% reduction in the error rate if the machine supports it!

The division of labor based on this began in the area where the opposite side was bad. The pathologist can better estimate that someone has breast cancer while the machine was better at saying that someone does not have breast cancer. As in other teams, the weaknesses of an individual are thus addressed, and better solutions are achieved. For machines it is much harder to make the right decisions in unknown situations with data poverty. In contrast, it is generally more difficult for people to quickly recognize the correct patterns on the basis of a large volume of data. This insight can be applied to cognitive work through two different approaches. Either the machine makes a suggestion and the person builds on this decision or the decision of a person is judged afterwards by the machine (cf. Agrawal, Gans, & Goldfarb, 2018, pp. 65–67). In any case it is again a **diagnostic-supporting application**.

The Danish AI software company ***FastCompany*** tested its *Corti* AI system by letting a computer listen when people in the **call center** answer emergency calls. When someone outside a hospital suffers cardiac arrest, time is crucial: the chance of survival decreases by about 10% every minute. Therefore, the first step in recognizing that a cardiac arrest is involved is a particular challenge for call center agents—after all, it is important to correctly understand the symptoms often transmitted by panicked friends or relatives (cf. Peters, 2018).

In Copenhagen, call center agents are therefore supported by the ***Corti* AI system**. When an ambulance is called, the AI Assistant *Corti* is also on the phone. NLP evaluates the conversation in context and provides the agent with real-time notifications based on this information. *Corti* not only analyses what and how a person said something (e.g. tone of voice), but also takes into account the background noise. This made it possible to detect heart attacks with a success rate of 93% compared to 73% in human assessments (cf. Peters, 2018).

6.2 Digital Twins and Human Brain Projects

Another AI research field in the healthcare sector is concerned with the **development of digital twins**. Section 2.5 already described the creation of such twins for machines and plants. The medical sector deals with the virtual (digital) representation of human organs (e.g. heart, kidney, liver) or the complete human being itself. The digital mirror images created in this way can be used to simulate the state of health and the effects of a therapy. The aim is to try out the right treatment methods—without turning the real person into a guinea pig.

Institutions and companies such as the *Fraunhofer Institute*, the *Helmholtz Association of German Research Centers* as well as *Siemens Healthineers* and *Philips* are working on the **artificial birth of digital twins**. Today, it is not yet possible to predict when the corresponding breakthroughs will be achieved. The vision is not only to carry out an **integrated evaluation of all relevant patient data** (such as laboratory values and data from CT and MRI examinations) using this digital twin. The target is to simulate the entire process from prevention to diagnosis, therapy and aftercare—and on this basis to establish optimal patient care (cf. n.a., 2018a, p. 18). This is a **diagnostic and therapy supporting application**.

The following development has been observed in this field. In the past, scientists gained their knowledge "in vivo", i.e. by observing or experimenting with living organisms. Later, such experiments can be carried out "in vitro", i.e. in a test tube. Now the step to "**in silico**" is preferred because such experiments now take place in the computer—and their chips are based on the chemical element silicon.

Another AI application field tries to encode the secrets of the human brain. The new findings will make it possible to develop alternative treatment methods for neural diseases. The **Human Brain Project** (HBP) is one such an initiative. Here, an interdisciplinary team of experts consisting of scientists is striving to pass on their results through a "Medical Informatics Platform". These relevant findings result from the combination of patient data, the knowledge of neuroscience and the results of clinical research (cf. HBP, 2017).

At the European level, these developments are being driven forward by a major **EU funding project**. The aim is to penetrate the processes in the brain even more precisely in order to use the findings there for AI systems. Originally, the human brain was to be simulated by a computer within ten years. This objective has long since been abandoned. A reproduction of the "general" intelligence of humans still represents an insurmountable obstacle for researchers (cf. Wolfangel, 2018, p. 33).

The **Human Genome Project** is already delivering tangible results. In 2003, the human genome was decoded after thirteen years at a total cost of US-$ 2.3 billion. Today, the same analysis often costs less than US-$ 100—and takes only a fraction of the time (cf. NHGRI, 2016). Depending on the respective data protection situation, the information generated in this way could be supplemented by further personal data. These can be obtained through wearables, apps or access to social media content. In this way, an **individual health status** could be created that also includes all genetic predispositions. Based on this, an **individual nutrition** plan

could be developed that exactly corresponds to the genetic profile of the user. In addition, it would be possible to derive an **individualized medication** (keyword **individualized medicine**) that optimally weighs effects and side effects on the individual organism with its particular characteristics (cf.McKinsey, 2013, pp. 90−92; Taverniti & Guglielmetti, 2012, pp. 3−5).

In this context, the so-called ***Angelina Jolie* effect** is spoken of. What happened? In May 2013, *Angelina Jolie* announced that she had both breasts amputated to protect herself against breast cancer. Her personal risk of developing breast cancer had been particularly high due to a particular genetic trait. This characteristic was recognized by a gene analysis. Since then, more and more breast cancer genetic tests have been carried out because women want to know their personal cancer risk. With certain genetic characteristics, the risk of developing breast cancer increases to up to 80% (cf. n.a., 2016b).

In 2018, the following case was reported from China: For the first time, a researcher had manipulated human embryos by using the so-called **gene scissors** (officially *Crispr/Cas*9) in such a way that they could no longer contract AIDS. These gene scissors were used in the course of in vitro fertilization. The “experiment” carried out on people was discussed very critically worldwide (cf. Kastilan, 2018, p. 64).

Food for Thought

Do we want such **transparency** about every single individual (including our own genome)—including ourselves—in order to be able to live “optimally”? Should such an analysis be carried out prenatally—with various possible decisions?

Or do we want to give life something of its **uncertainty**, its **unpredictability**, its **imponderability** and its **surprises**—good as well as bad? Because this field of tension may make life worth living—because we do not know and cannot know everything. Can we still live a real life if we know early on what will cause our death and when? Would we be blinded by all these precautions for the positive things in life just because we have a 94% chance of dying of kidney failure at the age of 62?

It becomes clear that both over-information and under-information will have negative effects. Therefore, these questions should be raised and answered early—without, however, missing the starting signal for AI deployment, which in our opinion is necessary.

Memory Box

If you want to know what developments *Amazon* can expect in health care, you should google the keyword *Amazon 1492*. Not for nothing did *Amazon* use the year of America’s discovery for this project!

Simpler **forms of self-optimization** are supported by skills from *Alexa* (cf. Fritsche, 2018). The German health insurance company *Techniker Krankenkasse* (TK) has developed the ***Alexa Skill TK Smart Relax*** to help *Alexa* users relax through smart meditation exercises. This should make it possible to integrate

mindfulness and relaxation techniques into everyday life. With the command "Alexa, start smart relax" the user is invited to different relaxation and mediation units. Alternatively, different playlists can be called up to support concentration.

The connected shoes offered by the company Digitsole (2019) can also make a contribution to self-optimization. The **smartphone-controlled shoes** have an adjustable heating, shock absorption and tightening. To this end, electronics are integrated into the shoes in order to provide consumers with more comfort and well-being. AI algorithms detect fatigue symptoms and injury risks at an early stage. In addition, **personalized training recommendations** can be made, and **audio coaching** can be carried out. An integrated **activity tracker** continuously records speed, distance travelled, and the number of calories consumed. In combination with a fitness or health app, this leads to exciting business models.

Another example of this is the cooperation between the sports equipment manufacturer *Under Armour* and *IBM Watson*. In a common development—called ***HealthBox***—the AI system learns from physical activities, weight (incl. body mass index) and nutritional patterns something about the fitness state of the user and can derive recommendations for optimizing the training. The application consists of a *Fitbit*-like band, a digital scale and a heart rate monitor. A smartphone app called *UA Record* brings everything together to evaluate the data collected by the fitness tracker and a weighing scale. By working together with *IBM*, these data streams can be intelligently evaluated. Criteria such as age, sex and activity level are taken into account in order to give individual training and recovery recommendations. To market the *HealthBox*, *Under Armour* accesses three online fitness communities it has built up in recent years: *Endomondo, MapMyFitness* and *MyFitnessPal*. With this, the company is accessing the largest **wellness online ecosystem** with 165 million users today (cf. Under Armour, 2019).

Further developments are the chatbots and expert systems already in use today, which present themselves as **personal health managers**. Apps provide digital medical advice on common disease symptoms and often also offer a function to schedule further medical treatment. Apps can also remind patients to take the prescribed medication regularly to promote compliance. Compliance here means the willingness of a patient to actively participate in therapeutic measures, e.g. the regular taking of prescribed medicine. This is also an example of a therapy-supporting application.

Fictional Reading Tip

A very good fictional novel by *Marc Elsberg* "*Zero—They know everything you do*" shows where such attempts of self-optimization can lead.

6.3 AI-Based Medical Use Cases

Small companies also have the opportunity to enter the healthcare market with innovative solutions. The **Doctor App Ada** is a self-service application—an example of a therapy-supporting application. This startup company from Berlin started in 2011 with the development of a digital medical knowledge database. The company's goal was to provide everyone in the world with access to high-quality, personalized health information. The app was introduced in 2016 to achieve the goal of easy access to medical information. In 2017, the app became the No. 1 medical app in over 130 countries—both in the *Apple* app store and the *Google* play store. The number of users exceeded three million in 2018—and over five million symptom analyses were completed with Ada (cf. Ada, 2019). This app also links two AI applications to achieve a convincing solution for the user: an expert system with an NLP interface. The chatbot offers its help to the user and asks if he/she feels good. If the person has a complaint, the app provides an evaluation of the symptoms, whereupon a decision can be made about the next measures (cf. Fig. 6.1).

At the end of an extensive questioning process, which resembles a doctor's consultation, a diagnosis is made. This one cannot be called a diagnosis in many countries, because only doctors are allowed to make diagnoses. The result is much more a decision tree that assigns different probabilities to possible diagnoses. In this way, the software makes it transparent to the user how that assumption came to a certain conclusion (cf. Müller, 2018b, p. 114). This is a nice example of the Explainable AI mentioned in Sect. 1.1.

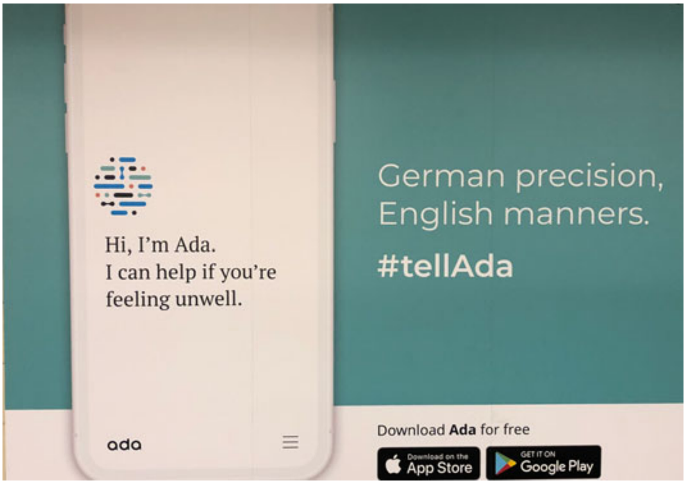

Fig. 6.1 *Ada*—Your health guide. *Source* Authors' own picture

In the future, *Ada* may also be able to evaluate photos or videos of the skin, sensor data, recordings of other apps (e.g. from fitness trackers) or gene data. Again, the challenge lies in the connection with other companies—possibly on an ***Ada* health platform**. Diagnoses and therapies may not be made on this basis, because in Germany the so-called **remote treatment prohibition** applies still. At the 121st German Medical Congress in 2018, the German medical profession voted by a large majority in favor of relaxing the ban on remote treatment. It is being worked towards the goal that physicians "in individual cases" may also provide exclusive advice or treatment via communication media to patients still unknown to them, if this a "medically justifiable and the necessary medical care" is maintained (cf. Höhl, 2018).

Cardiogram is an app that detects **irregularities of the heartbeat** with the help of an *Apple Watch*. The combination of data and prediction makes it possible to react immediately to deviations before a heart attack occurs. An accuracy of 97% is currently achieved. The precision of the results can be improved by collecting and comparing the heartbeat data of additional people. For each additional percentage point of accuracy, a disproportionately large amount of additional participant data is required (cf. Agrawal et al., 2018, pp. 45−49).

The company ***DeepMind Health***, founded in Great Britain in 2010, is pursuing a larger approach. This company has set itself the goal of making the most advanced (AI) technologies available to patients, nursing staff and physicians. The company was taken over by *Alphabet* in 2014 (cf. DeepMind Health, 2019a). The use of state-of-the-art technology is intended to prevent people from becoming seriously ill or even dying because they do not receive the right treatment in time. Many healthcare systems still lack the necessary tools to immediately analyse test results, determine the necessary treatment and ensure that every single patient requiring complex or urgent treatment is sent directly to the right specialist. To achieve this, *DeepMind Health* works with hospitals on mobile devices using AI solutions to get patients from testing to treatment as quickly and accurately as possible.

Streams is a corresponding app currently in use at the *Royal Free London NHS Foundation Trust*. It uses mobile technologies to notify doctors immediately if a patient's condition deteriorates significantly. An example is shown below, which refers to changes in kidney functions and especially to acute kidney injury (AKI) and indicates immediate need for action. Therefore, one day in the life of *Streams* at the *Royal Free* measured in February 2017 (cf. Deepmind Health, 2019b) is shown here:

- 2,211 blood tests analysed
- 66 changes in kidney function identified
- 23 AKI alerts issued
- 11 cases required action.

Additionally, the 11 cases which required action included potentially fatal sepsis and rise in potassium, 60% could be reviewed in less than one minute and two critical cases were reviewed remotely. This application is a combination of **diagnostic and therapy supporting applications**.

An example of a therapy-supporting application is **AI-assisted surgery**. Their use, e.g. in microsurgical procedures, can ideally prevent performance fluctuations that are peculiar to human surgeons. A study with 379 orthopedic patients showed that AI-assisted surgery led to five times less serious complications than those experienced by surgeons operating alone. Robots are also already being used for eye operations. The most advanced surgical robot currently available, *Da Vinci*, enables physicians to perform complex procedures with more control than conventional approaches (cf. Marr, 2018). During operations, the doctor is no longer standing at the operating table, but at a console near the patient. From there he or she controls the robot on the basis of a three-dimensional image of the operating area. This supports the eyes and hands of the operator. Today, the fields of application of surgical robots concentrate on urology, lung and abdominal surgery. In the future, robots will be used on long space missions—to Mars, for example—to assist in operations such as appendectomy or dental treatment. Such missions are to be carried out remotely by doctors on earth.

It is to be expected that Artificial Intelligence will be able to combine its advantages of being able to evaluate large amounts of data with the use of robots. Robots can analyse data from medical pre-examinations in order to subsequently guide a surgeon's instruments during surgery. Forecasts assume that this will lead to a 21% reduction in a patient's hospital stay (cf. Marr, 2018). Using Artificial Intelligence, robots can also evaluate data from previous operations in order to develop new surgical techniques. Corresponding studies have already turned out to be very promising.

These options will help to reduce surgical inefficiencies and thus the poor results of surgery. In addition, insights gained here can be linked to the postoperative and long-term health outcomes of a patient. This again requires a **closed patient data cycle**.

The hospital processes can also be supported by **virtual nurses**. From interacting with patients to briefing patients in the required departments, virtual health care assistants can help. Since virtual nurses are available 24/7, they can continuously monitor the condition of patients and answer questions. Today, applications of virtual nursing assistants often concentrate on the regular communication between patients and service providers. A connection to the already discussed health apps offers the possibility to connect the phases of the disease with the—hopefully dominating—phases of health in a closed cycle. Thus, the virtual nurse becomes a **virtual health agent** who points out necessary wellness checks, monitors weight and sports activities and, if necessary, suggests meals and gives impulses when it is time to go to sleep.

The ***EDAN*** system represents an important development step towards a **virtual care robot**. *EDAN* is supposed to support people with severe motor impairments. A lightweight robot arm with five-finger hand provides a high level of safety for the

user and supports a variety of interactions with the environment. No joysticks are used for control; rather, muscle signals on the skin surface (electromyography, EMG) are measured and then processed to generate motion commands for the robot. In order to make the use of the robot as easy as possible, so-called shared control techniques are used. The robot uses its extensive knowledge to predict the user's intentions and assist in the execution of the task accordingly. If the robot detects that a glass can be drunk, the motion commands decoded from the EMG signals are adapted and the hand is guided safely to the glass (cf. DLR, 2019).

Memory Box
Already today, **robots** can be used in the **domestic environment**, for example to keep elderly single people company. As a 77-year-old test user of a robot put it so nicely: "… I thought that such a robot could be a nice change. The first night, I felt really queasy. I know computers can crash. So, what if the robot crashes and goes crazy, too? … But even for me the robot means a better quality of life. Within a very short time, I felt responsible. And it already has something for itself if someone takes you back with 'Welcome, Dietlind. It's nice to have you back' when you come into the apartment door." (Backes, 2018, p. 119).

In addition, AI systems can also support the further **management of administrative tasks** in the healthcare sector. Intelligent language assistants can simplify communication between service providers—and produce written documentation about them if required. Therapy plans, orders of medication etc. can also be supported via AI systems. An example of the use of Artificial Intelligence to support administrative tasks is a partnership between *Cleveland Clinic* and *IBM Watson*. The AI application supports the evaluation of large amounts of data and helps doctors to develop more personalized and efficient treatments (cf. Marr, 2018).

Food for Thought
Perhaps by relieving routine tasks in the health sector, doctors and nursing staff will be able to concentrate again on those tasks in which they are (still?) indispensable—in the appreciative and compassionate conversation with the patient.

Robots in hospital logistics represent a further developed field of application in healthcare. *Panasonic* has developed a robot called ***HOSPI***, which can bring sensitive drugs, bulk packs, patient files and laboratory samples to the wards and patients. This should save time for the medical personnel, which can ideally be used for the care and nursing of the patients. A total of four *HOSPI* robots are in use at *Changi General Hospital* in Singapore. They can deliver shipments autonomously to all stations within the site−24/7! The only interruptions are the scheduled charging phases and maintenance intervals. The robot uses a large number of sensors to independently avoid obstacles such as patient beds, wheelchairs, visitors and personnel. A *HOSPI* weighs 170 kg and can currently transport 20 kg (cf. Panasonic, 2019).

All in all, **AI-supported developments in healthcare** can be summarized as follows (cf. McKinsey, 2017, p. 63; Hahn & Schreiber, 2018, p. 342):

- AI systems enable **remote diagnosis of the health status of patients** via a mobile device. For this purpose, the recorded information is compared with databases in order to make nutritional and exercise recommendations or to point out possible illnesses.
- AI tools support the **analysis of the patient's medical history** and also bind a large number of environmental factors of the patients. This enables **people with specific health risks to be identified** and transferred to prevention programs.
- **Virtual agents** can refer registered patients to appropriate physicians in interactive **health/prevention kiosks** to avoid referrals errors and waiting times.
- **Autonomous AI-based diagnostic devices** perform simple medical tests without human assistance. In this way, doctors and nursing staff can be relieved of routine tasks.
- Instead of diagnostics after patient admission, **decentralized early detection and diagnostics** through wearables etc. are possible. This supports a development from a primarily reactive medicine to a **proactive preventive medicine**.
- **AI-powered diagnostic tools** can ideally identify diseases faster and with greater accuracy because a large amount of historical medical data and patient records can be accessed in real-time.
- **Individualized treatment plans** can be developed using AI tools. The aim is to improve the efficiency of therapies by tailoring treatment more comprehensively to the needs of specific patients.
- Medical care can develop from a one-size-fits-all medicine to an **individualized medicine**, if necessary, with individually composed medications.
- The **use of digital twins** reduces the need for trial-and-error therapy through **"objectified" planning and prediction of therapy combinations**.
- AI algorithms support the **management of hospital operations**. In this way, staff deployment plans and the medicines available can be aligned with medical and environmental factors. This includes the behavior of the patients, the expected course of disease or recovery as well as regional and seasonal factors (e.g. expected influenza waves).
- Results obtained through Artificial Intelligence on the **development of health in the population as a whole** provide health payers with the opportunity to develop preventive measures. This could reduce the cost of hospitalization and treatment in general.

The extent to which the desired developments in health care can actually be exploited in a country depends on the **availability and evaluability of the necessary data**. As long as the health data is distributed over a large number of practices, hospitals, pharmacies and health insurance companies, there will be no holistic picture per patient. This holistic picture is missing not only for the analysis per patient, but also for the training of the AI algorithms.

A look at the **status quo in Germany** shows that in many cases the above-mentioned **potential in the health care system** has not yet been exhausted (cf. Bertelsmann Stiftung, 2016, pp. 1–8):

- Many **digital health applications** have the potential for patient empowerment and can contribute to improving medical care.
- The range of corresponding services is developing dynamically. There are already over 100,000 **health apps** today. 29% of Germans have already installed health apps on their smartphones.
- Over 50% of online users in Germany search the Internet at least once a year for **health-related information**.
- This development takes place primarily in the **second health market**—i.e. outside the classical health system. In addition to many startups, the Internet giants who are penetrating the healthcare market with new ideas also dominate here.
- Many **solutions are driven by supply**; they are less geared to the actual need for prevention and health care.
- The market remains largely **non-transparent** because there is a lack of procedures for identifying and evaluating innovations.
- **Healthcare providers** are called upon to actively seize the opportunities offered by digital technologies and translate them into customer-oriented solutions.

Food for Thought

Despite all the euphoria about the possibilities offered by AI applications in the healthcare sector, **the relevance of the doctor-patient discussion** should not be neglected. What great success has already been achieved by the administration of placebo preparations, because the compassionate words of the doctor and/or the simple belief in healing brought success?

With the advance of Artificial Intelligence, pure expert knowledge will lose its significance. The "good" doctor of tomorrow is more characterized by empathy and a high degree of communication skills. "Doctors who cannot do this or who do not attach importance to it will become superfluous at some point in the future" (Bittner, 2018, p. 19).

There is also the **danger of overuse through over therapy**, because with all the possible symptoms that would have been successfully "treated" by sleeping through the night in the past, the AI doctor, who is always available on the move, is now consulted—with shocking information about what it could all be!

It should not be concealed at this point that the **use of Artificial Intelligence also takes place in the porn industry**. Examples of this are the abuse of Artificial Intelligence by copying the VIP faces of *Scarlett Johansson* and *Taylor Swift* onto the faces of "classic" porn actresses. This is the phenomenon of the so-called **deep fake** (cf. Kühl, 2018).

The human-like appearance of humanoid robots also opens up new fields of application in this field. The *Abyss Creations* produces ***RealDoll***, a sex doll with adjustable stimulation and additional features to conduct conversations and tell jokes. How are these new toys discussed (Chris, 2017)?

Dawn of the Sexbots

The step from 'Westworld' into your arms: an AI-equipped artificial lover with customizable look, voice, personality and sex drive. Could it be your perfect companion?

In 2017, the first brothels with sex robots were advertised in Ireland and Germany (cf. Maher, 2017; Petter, 2017). This shows how Artificial Intelligence can also intervene in the most intimate areas of human beings. In addition to all ethical reservations, it offers legal sex alternatives (cf. Krex, 2017).

6.4 AI-Supported Education

For decades, people have been discussing how to revolutionize education through technology. **AI-supported analyses and forecasts** can support those responsible for education systems in an important task: balancing people's needs (in terms of skills and job aspirations) with the requirements of future employers. In theory, this will make it possible for curricula to be adapted to the demands of future working life at an early stage, so as to provide qualifications that will not be required yesterday or today, but tomorrow. Unfortunately, in most countries this will remain fiction.

Current trends focus more strongly on digital learning platforms, blended learning, MOOCs (massive open online courses) as well as paid online learning platforms. It can be seen that the way content is presented is changing more and more from text to visual information—we could also say from *Google* to *YouTube*. **Digital learning platforms** are already used in academic teaching (e.g. *Moodle*). There, lecturers can make learning content available online, communicate dates, inform courses about changes and create glossaries. Learners can download this information, view timetables, course participants and messages, and upload their own contributions if necessary. The university thus becomes mobile and can be called up anywhere (cf. Igel, 2018).

In school education in Germany, a **school cloud** is already being used in some cases. This is being developed and tested by the *Hasso Plattner Institute* together with 300 schools in the *MINT-EC school network*. The project is funded by the *Federal Ministry of Education and Research*. However, these systems are not yet truly "intelligent". Initially, they only allow to network teachers, students and learning material—but they offer a springboard for more!

It is important that **school and university education** does not focus on rigid rote learning in fixed structures but promotes independent learning in unstructured learning environments—in order to develop **creativity** and **initiative**. It makes little sense to teach students in a digital world how to memorize information that can be retrieved at any time using a mobile device. Nevertheless, it is indispensable to build up one's own knowledge—this provides the basis for the development of one's own values and offers the prerequisite for well-founded decisions and one's own creativity.

Memory Box

Somebody Who Knows Nothing Must Believe Everything!

Beyond factual knowledge, it is above all important to build up one's **own media competence** in order to be able to work competently with various sources. People who want to justify complex interrelations monocausally have to be met critically. Motto: X is all Y's fault. That's how populists "explain" the world! It is necessary to get to the bottom of the **complexity of facts** independently in order to frequently recognize that there are large differences between correlations and causalities (cf. Kreutzer, 2019, pp. 1–33).

Memory Box

To **prepare for the future world of work**, forms of knowledge transfer and competence acquisition are needed that promote creativity, problem-solving skills, self-organization, initiative, appreciative and problem-solving communication and thinking in context.

Blended learning can make a contribution to this. This is a mixture of different learning concepts, such as online courses and face-to-face events. The use of AI can help to ensure that the online learning materials are more closely geared to the individual learning level of the participant in order to help them to overcome individual learning hurdles. **Intelligent tutoring systems** (ITS), which are used in combination with online learning, contribute to this. Natural language processing is a key technology for language learning systems such as ***Carnegie Speech*** or ***Duolingo***. Intelligent tutoring systems such as *Carnegie Cognitive Tutor for Mathematics* are already in use in US high schools. Such systems are also used for advanced training in medical diagnostics, genetics or chemistry. Based on the respective user-machine interactions, **personal advice for the improvement of learning outcomes** is presented, which cannot usually be provided by teachers of large classes (cf. Stanford University, 2016, pp. 31–33). Cloud programs like ***Bettermarks*** help students to improve their skills in mathematics through the use of new digital media. In a comprehensive meta-study on the effectiveness of adaptive learning systems with a focus on languages and mathematics, **positive learning effects were confirmed in the majority of the studies** (cf. Escueta et al., 2017).

Massive Open Online Courses (MOOCs) represent another important learning and analysis environment for Artificial Intelligence. MOOCs are online courses in higher education and adult education that often reach high numbers of participants due to the lack of access and admission restrictions. The interactions recorded online provide insights into how participants learn, where they "fight" or make good progress, when they break off, etc. The interactions are recorded online and can be used for a variety of purposes. In this way, conclusions can be drawn as to where additional assistance is necessary to ensure learning success (cf. Stanford University, 2016, pp. 31–33). Overall, it can be said that AI technologies are very well suited to support the **achievement of individual educational goals**.

Food for Thought
Could a **MOOC-based education push in African countries** succeed in slowing down the population explosion that is looming there? In many countries it has been observed that the increasing education of the population leads to a higher standard of living, which results in a slowdown in population growth. Then such investments would be an important contribution to the survival of our planet.

In addition to the MOOCs, **paid online training courses** using AI technologies are becoming established. One example of this is the education website ***Lynda.com***, taken over by *LinkedIn* in 2015. This platform supports the development of managers and executives through a variety of online courses (cf. Lynda, 2019).

Automated image recognition can be supported by the use of webcams to detect signs of boredom, commitment, mental under- or overload and/or a possible interruption of the learning process in gestures and facial expressions. Such *Class Care Systems* are already applied in China (cf. Böge, 2019, p. 4). In Great Britain, for example, image and speech recognition were used to **identify learning difficulties and learning preferences of students**. For this purpose, previously unusual data and data sources were also used, e.g. the activities of learners in social networks. Based on such insights, Artificial Intelligence can improve learning and teaching through greater individualization. For each participant, **indicators of learning success** can be identified that were previously unknown. In addition, the **individual learning process can be continuously monitored**. This refers not only to the number of pauses a learner takes during a lesson, but also to the time it takes to answer a question. The number of attempts to answer a question before it has been answered correctly can also be evaluated. Image recognition, eye tracking, analysis of mouse movements and an emotional analysis of the learner can provide deeper insights into performance, thinking and cognitive abilities—if the provider has received a permission in each case. A more **individual support of the learning process** becomes possible (cf. McKinsey, 2017, p. 66f.).

The question is whether we can or want to achieve this on a broader basis. On the one hand, it is about the **ethical question of the comprehensive monitoring of learners**, whose privacy would be deeply invaded. On the other hand, there is the question of the **necessary investments** that would accompany such a comprehensive approach. It is likely that such comprehensive concepts will soon only be used in particularly critical areas (e.g. in the case of massive learning disorders). In addition, they can be used where there are large financial resources, e.g. in privately financed educational institutions and in the military sector (cf. Sect. 9.2). As mentioned before the necessary systems are already implemented in China where the installation of cameras in schools and the permission of the parents is no issue to talk about (cf. Böge, 2019, p. 4).

In our opinion, an interesting use of AI is to enable learners to carry out **self-control over the learning process**, based on an in-depth analysis of this process. With such a—permission-based—evaluation the individual would be promoted purposefully. At the same time, anonymous training data could be obtained for the further development of the AI algorithms.

Here, the use of the **knowledge gained about optimal learning support** does not have to stop at the school or university boundary. The **individual learning profile**, which can change over time, would accompany the learner throughout life. He or she could be repeatedly referred to additional relevant learning content in order to prevent the increasingly rapid obsolescence of knowledge. At the same time, the relevant learning content could be prepared in a form that corresponds to the respective learning preferences.

The need for this is derived from the **challenge for all** to ensure **lifelong learning**. Because education and training in every country and in every company requires a strategic reorientation and further development in order to meet the challenges of the labor market. Figure 6.2 shows the **strategic qualification gap** to be closed. Today's (public) educational efforts focus on early childhood education, school education, vocational training at the start of working life and higher education (keyword: **qualifying**). This largely ignores the fact that people devote their longest time—often more than 40 years—to professional activities, where the demands are changing ever more rapidly and to an ever-greater extent. Here, the necessity of a **re-qualifying** arises. Not only the generation of baby boomers who will leave the labor market in the next few years will have to prove themselves in a working environment for which neither schools nor universities have been able to adequately prepare. The possibilities of the Internet, the challenges of digitalization and Artificial Intelligence were not part of the content of the study at the time, because these developments were not yet apparent. Also, typewriters rather than computers were standard equipment for a student who also had to get by without a smartphone, *Facebook* and *Amazon*—and still survived!

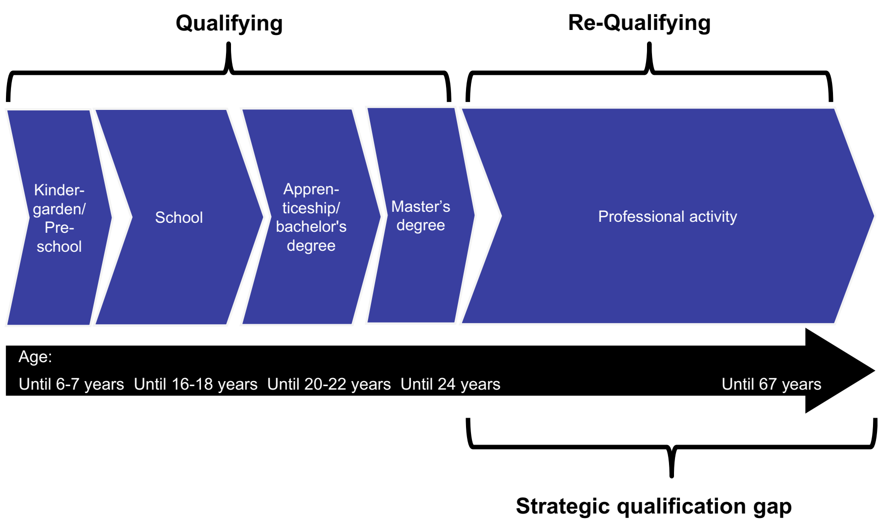

Fig. 6.2 Strategic qualification gap. *Source* Authors' own figure

The **dynamics of changes in professional life** continue to accelerate in subsequent generations. The following developments illustrate this:

- Today, hundreds of thousands of employees perform functions that did not even exist 20 years ago: App developers, community managers, UX designers (UX stands for user experience), SEO specialists (SEO means search engine optimization), social media managers, big data analysts, cloud service managers, CDOs (Chief Digital Officers), AI developers, machine learning specialists, etc.
- Accordingly, 70% of today's pupils are expected to work in jobs that do not yet exist.
- In ten years, employees will be working with technologies that are not yet operational today; quantum computing and smart dust should be considered here (cf. the *Gartner hype cycle* in Fig. 2.6).
- The future employees will have to solve problems that are not yet known today.

In order to successfully shape this change as a company and as a society, the strategic qualification gap must be systematically closed by **re-qualifying**. It is important that no employee waits for the company to do something for him or her. Here, rather a high measure of **self-initiative is demanded for closing the strategic qualification gap**, if the own employer did not recognize the indications of the time or did not act appropriately.

Food for Thought
The **elaboration of individual learning and teaching profiles** as well as the **educational offers** based on them represent an exciting field for schools and universities as well as for governments. This could make a significant contribution to closing the strategic qualification gap at national level.

What role would the lecturers play in such an **AI-controlled world**? First of all, time-consuming administrative tasks such as monitoring and answering routine questions could be eliminated. This gave the lecturers more time to train themselves continuously. This is because the strategic qualification gap also occurs with lecturers who do not actively work towards closing it. Overall, the lecturers would be more closely involved in the **qualification process as mentors and coaches**. This requires specific skills such as emotional intelligence, creativity and appreciative communication. Machines will probably not be able to learn this skill so quickly in the next few years.

In some areas of classical learning, AI systems can also replace the lecturer. This applies for the evaluation of simple written elaborations as well as for the answering of routine questions of students. In the **evaluation of written performances**, AI-controlled machines make progress. Companies such as GradeScope (2019) already support lecturers in correcting written papers and promise time savings of 50%. Here, the company relies on image recognition to decrypt the handwriting—which even a lecturer today still has to fail many times over. Based on defined learning contents, an automatic evaluation of the exam performance can take place.

Today's technology focuses only on elaborations with objectively correct answers, e.g. for mathematical tasks. Artificial Intelligence can also assist in rule-based learning, for example in checking spelling or recapitulating historical events. An evaluative interpretation of such historical events eludes automated evaluation—and this will probably always remain so. After all, history, as we all know, is written by the winners; most losers have a completely different view of things!

In addition, a **virtual supervisor** could monitor and support the work and conduct of the lecturers, as briefly described above. These virtual supervisors could send **alert messages** to the instructor if many students fail on certain tasks or tend to cancel a course. Even in the case of poor or best performance, proactive information can be sent to the responsible manager. In this way, important feedback discussions and motivating words can be used to support learning success in the long term.

UNESCO estimates that 24.4 million **primary school teachers** worldwide must be recruited and trained to ensure universal primary education by 2030. A further 44.4 million teachers are needed to fill **vacancies in secondary schools**. Many of these new hires (more than 85% in primary schools) are needed to compensate for fluctuation (cf. McKinsey, 2017, p. 68). Is it still a dream or is it a real possibility to satisfy this enormous need for teachers—at least in part—through Artificial Intelligence systems? The need for this is particularly great in Third World countries, where many people often have limited or no access to education. AI systems could contribute to the **democratization of education** via the Internet—depending on to the respective governments and the existing infrastructure.

Learning robots can be used more as a supplement than as a replacement for (missing) teachers to enrich teaching. Due to their haptic properties and attractive design, learning robots are particularly inviting for children and awaken their spirit of discovery. With regard to technical topics, the little helpers are particularly motivating. Robots such as *Dash & Dot* even provide children with their first programming experience by allowing them to develop creative applications on the tablet. A pedagogical concept that must stand behind the playful applications is a trailblazer for successful use. They serve the teacher in school as a didactic aid and should neither replace him or her nor serve as a pure pastime.

Once again, it shows that AI approaches are an exciting extension and less a substitute for current training concepts. The challenge is called **blended learning**—a mixture of different learning concepts, e.g. online courses and face-to-face events, virtual supervisors, etc.

In China supervisors can evaluate the behavior of pupils—even in school far away—based on **face recognition** in real-time. This can give the teacher immediate feedback about his lessons (cf. Böge, 2019, p. 4):

- Are pupils interested or bored?
- Are pupils asleep?
- Are pupils intimidated?
- Are pupils active in class?
- Do pupils talk to their peers?

This information is immediately transmitted to a control center and can be provided to the teacher, too, so that he or she can react to it. The parents in China are also interested in these finding. They want to check whether the pupils are as ambitious as expected.

Adapted learning materials can provide a bored child with playful content in order to motivate him or her to deal with the current material. As soon as the interest is awakened again, the complexity of the task can be increased bit by bit—individually for each child. This enables the highest possible **individualization of teaching in the classroom**. This is the future—also in China!

In Switzerland they even go the next step. Here, not only the **facial expressions of the students** are evaluated, but also their **motoric activities** during the lesson by means of IoT sensors. Does the child sit quiet or does it slide back and forth in excitement? What was the trigger for the sudden restlessness (cf. Igel, 2018)?

A technology mix that also integrates AI systems is currently increasingly being used in the **professional training sector**. Through the use of **virtual reality (VR)** glasses, educational content can be reproduced more realistically. Oriented towards the gaming industry, virtual worlds are created in which the learner is trained in situations relevant to practice:

- A prospective **steward** simulates the behavior in case of an emergency landing.
- The **midwife** must decide in a training unit which special challenges are connected with a twin birth and how these can be mastered.
- The **machine builder** recognizes the consequences the incorrectly installed valve would have on the production process.

Based on AI algorithms, weak points of the learner can be detected and reacted to accordingly. At the same time, the consequences of wrong decisions can be simulated without harming anyone.

There are already various approaches to **augmented reality** (AR) for everyday professional life, which can be used to support employees in their work in a targeted and individual way. Special data glasses (smart glasses) or tablets are linked with the data from running processes of plants and/or machines. Instructions for the next working steps are thus displayed directly to the wearer of the spectacles.

ThyssenKrupp relies on mixed reality for the **maintenance of its elevators**. The ***HoloLens* technology** from *Microsoft* is used for this purpose. These glasses generate a mixed reality to support a safer and faster work of the 24,000 service employees of the elevator company. These special glasses show the service technician the specific characteristics of an elevator even before he or she starts work. On site, the *HoloLens* enables access to all technical information of the elevator via augmented reality. If necessary, expert support can be requested immediately via image transmission. Since the information about the glasses can be requested and read, the hands remain free to work. First experiments have shown that the work can be done up to four times faster with the support of *HoloLens* (cf. Virtuel-Reality-Magazin, 2016).

Augmented reality glasses of this kind can also support apprentices, career starters and unskilled personnel in training programs. Also courses of action and work processes, which rarely occur, can be supported by AR glasses. In the event of incorrect operation, a red signal may appear in the AR glasses or on a tablet to prompt the operator for immediate correction. Specialists and skilled workers can be informed about the current progress of the process at any time via the corresponding devices. The information and instructions transmitted are based on real-time measurements incorporated into IoT technology.

Large training companies such as *Airbus, Boing, Daimler, General Electric, General Motors, Siemens* and *Volkswagen* use such **digital assistance systems** to optimize learning processes in professional training. The more qualified the learners already are, the more important it is to give them **control over their own education**. This is called **owning learning**.

Food for Thought
The predicate "Digital Natives" (from 1980 onwards) incorrectly assumes that these persons already possess comprehensive **digital competence**. However, this is often not the case. The digital competence of these persons often does not extend beyond the mere **operating competence of applications**. In addition, the majority of them are not able to distinguish between credible and untrustworthy content on the Internet.

In education, the use of new technologies will not lead to digital automatism. The **management of education** is still about a mix of teaching and learning. An AI system should therefore be understood as a meaningful didactic addition—but not as a substitution for the lecturer (cf. Igel, 2018). In addition, we should keep in mind that an educator is not only to be understood as a pure knowledge mediator but can also contribute to the development of the personality of each individual learner.

6.5 AI-Supported Human Resource Management

AI systems can also support **personnel planning**, taking into account complex rules of engagement. In addition, knowledge **gaps within a company can be identified across departments and divisions**, which are then transferred to a **training agenda** (cf. May, 2016, p. 6). AI-supported pattern recognition in the evaluation of data on potential employees could improve recruitment results. Here, the prerequisite is that the data necessary for in-depth analyses are available for the development of the AI algorithms as well as for the application in the selection process itself. The protection of the privacy of individuals practiced in individual countries will determine the extent to which Artificial Intelligence can contribute to overcoming the strategic skills gap.

In addition, in many countries there is still a **great imbalance between the existing and the necessary qualifications of the population**. This can be caused by **inefficiencies in the education system** and by **labor market regulations** that do not balance supply and demand. This means that the existing potential of individual people and countries as a whole cannot be optimally exploited. Artificial Intelligence has a key role to play in achieving better **connectivity between education systems and the labor market**. Digital technologies are already making an important contribution to connect talents and tasks via online platforms. McKinsey (2017, p. 65) estimates that **online talent platforms** will make it possible by 2025 for up to 60 million people to find jobs that better match their skills or preferences. This can also reduce the costs of personnel management.

The following example shows how a **chatbot can already support a job search** today. The world of ***Jobo*** still looks natural and powerful here (Bobot, 2019):

Add *Jobo* on messenger

Get Started

Andre, welcome! Nice to see you here. I'm Jobo and I will help you to find your next job. Let's start with the basics. You can start a new job search from the menu or just by sending me a "search" command.

Search for jobs and setup your own job alarm

What are you looking for? Note: It is better to use more general keywords like: teacher, driver, sales manager or some skills like java, wordpress, html5 etc.

Developer

I've founded 5601 jobs for "Developer" in San Francisco.

(App shows results.)

Apply for jobs via messenger or directly. Good luck!

Options: More results | Save Search | Done

Do you want to apply for the following job?

Application Architect (Entry Level) at Varite USA in San Francisco, CA 94105

Options: Yes, please | No, forget it

Which difficulties a text-based chatbot like *Jobo* actually still has today becomes visible below. This is the slightly shortened **transcript of a conversation with *Jobo*** (Bös, 2018, p. C1):

"Hi, Jobo

Hi!

Can you find me a job?

Oops, I didn't get your message. Should I search for jobs by using "Can you find one for me" as a keyword?

No, forget it!

What do you want me to do now?

I'd like to know if you can look for jobs in Germany.

Thanks for using me.

You're welcome.

You have good manners.

I hope the good manners will help me find a job.

I'm happy to help. What can I do for you?

Like I said, find me a job!

Oops, I didn't get your message. Should I search for jobs by using "Find one for me" as my keyword?

No, forget it!

What do you want me to do now?

Can you just look for a teaching position?

All right!

Cool! In Germany!

Thanks for using me!

It's okay. But what about the jobs? Have you found any yet?

Oops, I didn't get your message. Should I look for jobs by saying, "It's okay. But what about them now? Have you found any yet?" as a keyword?

No, forget it!

What do you want me to do now?

Find jobs!

Okay, where would you like to find a job?

Frankfurt.

Okay, I'll look for jobs in Frankfurt, Germany. Right?

That's right!

What are you looking for?

Teacher. I already told you!

Oh, sorry, I couldn't get jobs for "Teacher. I already told you!" Try changing your search criteria, use simple keywords, or select a larger city in your area.

Okay, I'm changing my keyword.

You want to keep this place: Frankfurt?

That's right!

What are you looking for?

Teacher.

I found 21 jobs for "Teacher" in Frankfurt. Would you like to save this search and be informed about new job offers?

Thank you. I had enough of this.

Bye. Bye. I hope I was able to help a little. See you soon!"

Actually, many chatbots try to compensate still existing difficulties in speech recognition by a pure text communication—often with given input possibilities. The example above makes it clear that this does not always succeed convincingly.

Much more convincing are the results of the job search platform ***MoBerries*** based on the *Facebook Messenger*, which this example shows (cf. MoBerries, 2019):

"*Hello Marie. I'm Mo from MoBerries. Nice to meet you. I'll help you to find your next job.*

Search For Jobs!
Ok, tell me, where do you want to look for a job? Send me your current location, select one or just type a city name.

Berlin
Fine, now tell me, which job role are you looking for? Select a suggestion below or type your own job title.

Content Marketing
Look, I've found 1453 results for Content Marketing in Berlin."

Using predefined decision trees, *MoBerries* develops a dialog with the user that corresponds to a natural chat. As soon as the chatbot has received enough information, he compiles a list of relevant results.

In addition, AI algorithms can help to create texts with higher impact (e.g. for job advertisements). For this, Textio (cf. 2019) offers an interesting application with the name **augmented writing**. *Textio* evaluates large amounts of data provided worldwide by companies from all industries. A **predictive engine** uses this data to uncover meaningful patterns in the language that lead to more powerful communication and therefore better business results. The results obtained in each case generate further data in order to further advance the learning process through a learning loop.

How can augmented writing be used in the **application process**? To learn, millions of job offers and recruiting e-mails are evaluated. The knowledge gained in this way goes into augmented writing. In the application process, **augmented job posts** can soon be used to trigger particularly qualified applications. **Augmented recruiting e-mails** can then be used to address the most interesting candidates. For example, *Johnson & Johnson* increased the response rate of its applicants by 25% through e-mails with high *Textio* scores (cf. Textio, 2019).

Food for Thought
One thing should be emphasized about **HR support through Artificial Intelligence**: The final decision as to whether or not to hire a candidate should remain in the hands of the managers involved. Since Artificial General Intelligence is still lacking, the human being is a much better decision maker when assessing the coherence of a candidate for a job. After all, our intelligence is much more generic and can bring together words, gestures, facial expressions, pauses in the flow of speech, etc. with the sympathy or affinity that is decisive for successful cooperation. No AI system can do that right now!

Therefore, a pure **data-driven recruiting** or a **robot-recruiting** remains (still) a dream of the future, if you don't want to hire human robots yourself. Nevertheless, the search for potential candidates should not be done without Artificial Intelligence!

In the already cited study by McKinsey (2018, p. 21), the following additional value creation potentials were determined for **human resource management** over the next few years:

- **Employee productivity and efficiency**: US-$ 100–200 billion
- **Automation of tasks**: US-$ 100–200 billion
- **Analysis-driven human resource management**: US-$ 100 billion

These figures should motivate companies to go for an individual AI journey (cf. Sect. 10.3).

6.6 Summary

- There are many **fields of application for AI** in the healthcare sector.
- The **comprehensive evaluation of health data** is of particular importance.
- The evaluations can be based on anonymous data records in order, for example, to **increase the quality of diagnosis**.
- The **connection of personal health data** is indispensable for personal diagnosis and therapy.
- This opens up important fields of action in terms of **data protection law**.
- AI systems can also support **operations**.
- The use of Artificial Intelligence can lead to a **relief of routine tasks in health care**—so that doctors and nursing staff can spend more time with patients.
- Artificial Intelligence can make a significant contribution **to closing the strategic qualification gap in training and further** education.
- In addition to the **technical infrastructure**, this requires in particular the **education of the lecturers** themselves; because their knowledge is also becoming outdated faster and faster.

- The **development of learning support systems** is associated with great effort, which will only be provided by a few countries.
- A larger field of AI applications is already available in companies through applications of **virtual reality** and **augmented reality**.
- Artificial Intelligence can also provide support **in HR management**—e.g. in the acquisition of new employees.
- **Online platforms** can help to bring together supply and demand in the labour market.
- The use of **chatbots in recruiting** search still has a lot of room to grow!

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7 Fields of Application of Artificial Intelligence—Energy Sector, Smart Home, Mobility and Transport

Abstract

In this chapter you will understand that the success of smart grits and the penetration of smart meters depends on the security of these networks. The development of smart homes can lead to the development of new business models. With autonomous vehicles, Artificial Intelligence has the potential to significantly reduce congestion and accidents caused by human error. In addition to optimizing ground-based logistics chains, airspace will become increasingly important for logistics tasks. The existing logistics infrastructure can be used more effectively, significantly reducing resource consumption and emissions.

7.1 AI Applications in the Energy Sector

Artificial Intelligence is widely used in the energy sector. **Intelligent power grids** can increase security of supply and ideally lead to cost reductions. AI applications make a contribution at every stage of the value chain: from power generation to power transmission to the end customer. A particularly important area is the **forecast of supply and demand**. Here, the possibility of achieving an optimum balance has become increasingly difficult due to the increasing use of decentralized, renewable energy sources. Finally, the **volatility of power generation** increases with the number and variance of independently operating power sources. This poses major challenges for network management if network failures are to be avoided (cf. Liggesmeyer, Rombach, & Bomarius, 2018).

In most countries, **network modernization** and the **use of smart meters** are already underway to achieve a more dynamic match between supply and demand. Artificial Intelligence enables providers to better predict and optimize load distribution. **Smart grid initiatives** enable small, private energy producers (including individual households) to sell excess capacity to regional energy suppliers.

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In the USA, more than US-$9 billion in public and private funds have been invested in the **intelligent network infrastructure** since 2010. Europe, Sweden and Italy have replaced almost all meters with smart meters. In perspective, European countries can complete the changeover within ten years if relevant security risks can be managed. As early as 2011, China's *State Grid Corporation* announced plans to invest US-$45 billion in intelligent network technologies. Further US-$45 billion is to be invested between 2016 and 2020 (cf. McKinsey, 2017, p. 47f.).

DeepMind, an AI startup purchased by *Google*, is working with ***National Grid*** in the UK to predict supply and demand peaks. For this purpose, weather-related variables and smart meters are used as exogenous inputs. The objective is to reduce national energy consumption by 10% and to optimize the use of renewable energy (cf. McKinsey, 2017, p. 47).

AI-based systems can also help utilities assess the reliability of small suppliers (e.g. private households with solar installations). The service life and integration capability of the systems installed there could be predicted for this purpose. The **power grid** could develop into a **marketplace** where, in addition to traditional electricity producers, a large number of small players also offer electricity from various sources (e.g. car batteries, solar cells on the roof). **Intelligent network management** would help to integrate this large number of mini suppliers in such a way that supply and demand peaks can be better managed by intelligent storage concepts. The following **developments in the energy** sector may occur in the best-case scenario (cf. McKinsey, 2017, pp. 47–51).

- A large amount of data is collected via sensors and evaluated using AI algorithms. The knowledge gained allows an **increase in the efficiency of power generation** by optimally adapting the generation units to the respective wind and solar conditions.
- AI-supported forecasts make it possible to **anticipate supply and demand peaks**. This optimizes the energy mix from various power sources.
- The AI-supported processing of **data from smart meters** enables an energy supply based on individual usage habits, local weather conditions and other factors.
- **Smart wires** in combination with AI applications support an **intelligent power supply**. This allows network utilization to be optimized and supply security to be maintained at a high level.
- The field staff of the energy suppliers receive **real-time updates on technical problems** in the plants. This can shorten reaction times and prevent or shorten power outages (keyword predictive maintenance; cf. Sect. 5.3).
- **Insect-sized drones and robots** identify defects and inspect systems without interrupting production.
- All in all, **fewer technicians** are deployed. At the same time, they focus more on anticipatory problem solving and less on manual recording of the respective status quo. Documents are also automatically created, evaluated and forwarded in a targeted manner.

- **Virtual agents** are used in automated call centers of energy suppliers. **AI-based CRM systems** classify incoming queries according to their respective service history and support the forecasting of bad debts and the resolution of technical problems.

These positive effects will only occur if the networks are (can be) comprehensively supported against hacker attacks. Because the "smarter" the networks become, the more units are connected by them, the more (also uncontrollable) entry lanes for computer viruses there will be. Here, **cyber security** must act more foresighted than hacker armies in order to prevent entire regions or countries from sinking into darkness and standstill.

Fictional Reading Tip
If you want to get an idea of what happens when a smart grid is hacked, we recommend the work "*Blackout*" by *Marc Elsberg*. Stimulating and exciting entertainment at the highest level! Very worth reading!

7.2 Smart Home Applications

In this context, the concept of the **smart home** is of particular importance, because it can be ideally integrated into a smart grid and encompasses additional application possibilities. In essence, the smart home is a **living environment** that is comprehensively **connected both internally and externally**. In any case, it is a connection with the Internet to the outside world, possibly also a smart grid. Internally, depending on the residents' enthusiasm for technology, all possible and impossible devices and processes can be connected to the Internet and thus become "smart" (cf. also Bendel, 2019). The following areas can be considered for the use within a smart home:

- Windows and roller shutters
- Front door
- Garage
- Motion detector
- Camera and intercom system
- Smoke detector
- Lighting
- Socket
- Power storage
- Heating
- Kitchen utensils
- Washing machine
- Weather station
- Entertainment (music and video streaming).

The use of smart meters primarily pays off in terms of **energy efficiency**, even if potential savings effects have so far been rather limited. Appropriate smart home systems (including video surveillance, noise sensors and smoke detectors) should also contribute to the **operational safety** and **burglar resistance** of the residential complex. The most important driver for the acceptance of smart homes is **user convenience**. After all, these applications can be operated via the Internet—usually via apps on mobile devices. So, the following functions can be **controlled within an apartment** from any place in the world connected to the Internet:

- Brightness of the apartment
- Temperature, if necessary, even more comprehensive the climate of the apartment
- Volume of radio, TV and other sound systems
- Monitoring of the children's room (through web cams)
- Cooking processes in the kitchen (e.g. starting the oven, coffee machine, etc.)
- Insight into the refrigerator (through a camera installed there, which transmits recordings directly to the smartphone)
- Roller shutters, awnings
- Entrance doors and garages
- Washing machine.

An additional degree of **convenience** is achieved when certain functions no longer require initiatives from the resident, but are independently recognized as necessary by **(experience-based) AI algorithms**:

- The **garage** opens automatically when the user's vehicle has approached 50 m and the parking space in the garage is still available.
- Already 30−60 min before the expected arrival of the residents, the preferred room **climate** in the rooms used is controlled. This can be individual for each resident—depending on the time of day.
- With the **opening of the entrance door**, the preferred **illumination of the apartment** is set—again depending on the person.
- In some cases—possibly even based on the mood of the inhabitant (e.g. derived from his last *Facebook* or *Twitter* messages)—the **"appropriate" music** can be played (based on the preferences of each individual person stored at *Spotify*).
- Orientation on individual habits can also be made with the correctly tempered **bath water**.
- Depending on the individual stand-up routines, the **coffee machine** can be started automatically.
- The filling level of the **refrigerator, pantry and wine cellar** can be monitored automatically and lead to autonomous purchasing decisions (e.g. via *Alexa*).
- Depending on past or planned activities, **cleaning services** can be booked independently, and the corresponding personnel can be admitted to the apartment at a predefined time window (password-protected or via facial recognition).

- **Washing machines** can start automatically during times with the lowest nuisance to the occupants or when electricity costs are lowest and calculates the best time to hang up the laundry.
- The baby's sleep patterns indicate when the next nightly hunger is expected, and the previously boiled water can be heated in time to the ideal **temperature** for bottle preparation.

With an invitation to a 30th birthday, the following questions can be answered with AI support by evaluating the respective information streams:

- Who **accepted the invitation** to the celebration? (Analysis of *Facebook*, e-mail or *WhatsApp* messages)
- What are the **music preferences** of the guests? (Analysis of *Facebook* and *Spotify* profiles of guests)
- Which **food proposals** are acceptable for the guests—vegan, vegetarian, organic food, etc.? (Analysis of *Facebook, Pinterest* or *Instagram* profiles of guests or posts in *WhatsApp* groups)
- What are the **drinking habits** of the guests? (based on the *Facebook, Instagram* profiles of the guests or posts in *WhatsApp* groups)
- What **food purchases** should be made? (Evaluation of the refrigerator filling level)
- What **drinks** need I buy? (Depending on the position of the beverage stand)
- Are preferred **alcoholic and non-alcoholic beverages** on special offer until the time of the event? (Taking current offers and delivery conditions into account)
- Which **purchasing channels** are used? (Basis is the previous buying behavior)
- What would be suitable **gift suggestions** for the host? (Based on the host's *Facebook, Pinterest, Instagram* profiles and the preferences on *Netflix* and *Spotify*)
- How comprehensive must the **cleaning** be on the "day after"? (Based on photos and videos of earlier parties with the expected guests as well as on current photos of the rooms in which the celebration took place)
- Where should the **cleaning staff** be booked? (Based on possible positive evaluations of services like *Book-a-Tiger* or *Helpling* and/or existing contracts, also depending on availability and special offers).

Memory Box
In view of these developments, you are in demand to examine their relevance for you own business model. Where are opportunities for your own products and services in smart home development? How can your own business models be adapted or further developed?

The success of the most diverse **service robots** is already evident today. Global sales of service robots are expected to increase almost fivefold between 2018 and 2022 (cf. Fig. 7.1). These include mowing and vacuum robots, which are enjoying

increasing popularity. The success of windshield wiper robots, on the other hand, is still limited.

Viessmann, a specialist in building technology, is consistently developing its business model further in view of these opportunities. Through acquisitions and internal startups, a **subscription model for heat** was developed. *Viessmann* no longer sells heating, but the "**heat**" **service**. If this makes it possible to become part of smart home, further services "around the house" can be offered. As a result, the heating manufacturer develops into an **individual solution provider**. It is particularly important to set up the customer interface (cf. Mahler, 2018, p. 75f.).

An increasingly important area of smart home development is not yet at the center of attention: The **care and provision of the ageing population**. *IBM* has entered into a partnership with *Malteser International* in order to dedicate itself to this task. As part of this collaboration, more than 150 homes will be equipped with **IoT sensors** and **cognitive computing** to keep the elderly safe at home. If the sensors detect irregularities, relatives can be notified via a mobile app or emergency services can be called. Corresponding triggers can be water running for a long time, intensive smoke development or not switched off stove plates. Also, conspicuous behavior patterns can be defined as triggers. This includes, for example, when the entrance door is open during the normal sleep phase. If the toilet is visited four times per night—deviating from normal behavior—an alarm can be triggered. This can also be the case if the motion sensors do not report any activities within six hours during the "wake phase" (cf. Bauer, Hüfner, & Ruemping, 2018).

IBM's Elderly Care service offers several advantages (cf. Bauer et al., 2018):

- **Senior care as a central module of smart home**
  The connected use of sensors in smart home solutions makes it possible for elderly people—who actually need supervision—to stay longer in their own homes. This saves care costs and creates additional quality of life. A **24/7 monitoring of the residents** enables them to be helped quickly in emergencies.

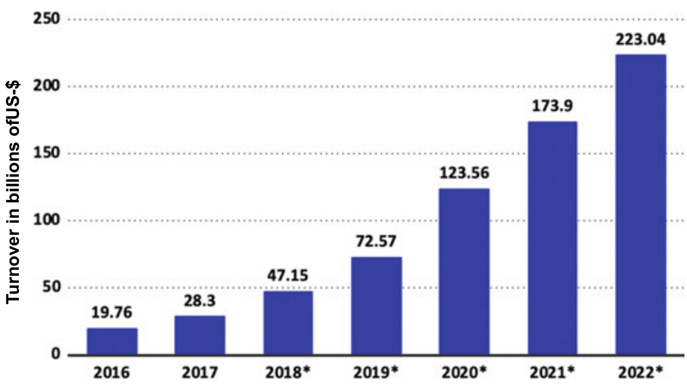

Fig. 7.1 Sales of service robots—worldwide 2016–2022 (in billion US-$). *Source* According to Tractica (2018)

In acute emergencies, **telemedicine** can be used—as part of domestic health care. This can relieve the burden on relatives and reduce possible absenteeism from work.
For housing companies, equipping the apartments with connected sensors offers the opportunity to further develop their business model in the direction of "health management".

- **Use of smart systems**
  A care system for the elderly should not only function perfectly from a technical point of view but should also meet the ergonomic requirements of its users. This also includes mobile alerts that attract attention without panic. A simple **traffic light system** can be used for this purpose:

  – Green: "Everything's fine."
  – Yellow: "Unusual behavior detected—there may be a problem."
  – Red: "Emergency requiring immediate attention."

In order to calibrate the system for the meaning of the colors red and yellow, user tests were carried out over several months.

The **app** used for this purpose enables relatives to exchange information about the condition of their parents through **one-touch communication**. Here is an example: "I received a yellow notification about Mom. Don't worry, I just checked on her. It's all right."

Through the **AI-based evaluation of the daily processes of each individual**, the software can independently detect abnormal and potentially dangerous behavior:

– What dwell time in bed can justify an alarm?
– How long can the refrigerator remain unopened without indicating a problem?
– Which movements at night are "normal"?
– What patterns of behavior at night can be a sign of a medical emergency?

The *Elderly Care* concept is an essentially IoT solution that supports a specific ecosystem. The relevant partners include real estate developers, emergency services, other health service providers, insurance companies and hardware and software providers. It is crucial that end-to-end user-friendliness is at its center right from the beginning (cf. Bauer et al., 2018).

A comparable offer comes from Better@Home (2019). The ***Better@Home*** concept, developed by ***IHP*** in cooperation with renowned providers, also offers solutions in the smart home and **ambient assisted living** (AAL) sectors. Again, the focus is on a **service platform**, which provides various services for the provision of age- and comfort-appropriate equipment for properties. This enables a customer-specific configuration of existing product and service offerings from a single source.

To solve problems, the gas or water shut-off tap can be operated from a distance and the stove switched off. In addition, specific devices such as home emergency call, bed sensor, medication box, blood pressure and blood glucose meter can be integrated into the monitor ring. The incoming information is evaluated by intelligent software to start individual **escalation processes**. For this purpose, the AI system learns the resident's movement profile in order to automatically generate notifications or alarm messages in the event of deviations (cf. Better@Home, 2019).

One possible development must not be ignored: from smart home to **smart terror**! In the USA, the technologies used in the smart home environment are already being used specifically to control and terrorize one's own ex-partner. Therefore, he or she changes e.g. the security code of the entrance door, so that the remaining partner cannot enter the apartment any more. In addition, the air conditioner cools the apartment extremely down in winter and loud music from the smart music system can be heard again and again at night without the remaining partner being able to do anything about it. Smart objects—equipped with camera and microphone—can additionally detect and record all movements in the apartment. Apps, digital personal assistants & Co. make it possible (cf. Bowles, 2018; Mezler, 2018, p. 1; Patrick, 2018; Woodlock, 2016).

Food for Thought

The smart home offers a wonderful **projection screen** for different groups. **Technology freaks** see the smart home as the fulfilment of their dreams, because their own living environment always knows exactly what is desired when and where—and then ideally delivers exactly that. This also includes the possibility of supporting older family members in their wish to be able to live as long as possible in their familiar surroundings.

Prophets of doom fear that hackers will be able to invade their own homes through inadequately protected Internet interfaces. Thus, not only processes can be manipulated, but possibly also the entire habits of a life community can be spied out. In addition, these people fear that the different software and hardware solutions—often with diverging update rhythms—may diverge and thus stand in the way of problem-free use. After all, uniform standards for such applications are still lacking.

It is up to you as a provider as well as a user of smart home solutions to decide where do you want to position yourself.

7.3 From Smart Home to Smart City

The development of smart homes can be thought further in the direction of the **smart city** concept for the future. With this approach, urban housing develops into a network of communication, logistics and information systems. At the same time, it aims at **sustainable growth** and a **high quality of life**. In addition, it should increase the **willingness to participate constructively in politics** (cf. Müller-Seitz,

Seiter, & Wenz, 2016, p. 4). The ideas for smart home can be seamlessly integrated into these concepts.

Smart mobility or **smart traffic** is a subarea of smart city. This is an intelligent interaction of various means of transport to improve the movement of people and goods. A higher level of safety can be achieved through mobility with **car-to-car communication** between the vehicles used. In addition, **logistic robots** can be integrated to transport people and goods. A large number of legal issues still need to be clarified in this respect. Finally, the increased use of sensors leads to an increasingly comprehensive encroachment on the privacy of individuals who are recorded during their everyday activities when using autonomous driving (cf. Stanford University, 2016, p. 23).

There is an interesting **pilot project** in Darmstadt. For this purpose, a **municipal traffic service** was installed which generates data on traffic flows in real-time and evaluates them with AI support. Cameras were installed at 272 intersections and over 2000 traffic lights. These generated more than one billion data sets in two years (cf. Darmstadt, 2019; Schmidt et al., 2016). The insights gained through AI solutions should lead to a more **intelligent control of traffic flows** and thus to a **relief of the inner city**. In addition, citizens have access to **information on the current traffic situation**.

The application of the US startup ***ZenCity*** goes far beyond this. The aim is, above all, to involve **citizens' opinions** more in urban decision-making processes. A large number of data points from the interactions with the residents are collected and converted into decision-relevant findings by AI systems in real-time. The following service fields are covered (cf. ZenCity, 2019):

- **Recognition of relevant topics**
  By automatically recording ongoing communication in the social media, chat rooms and city hotlines, the **topics that are relevant from the citizens' point of view** can be made visible to **city administrations**.
- **In-depth analyses**
  A further evaluation shows where which **topics** are discussed via which **channels** and with which **keywords**. If required, the analysis can go down to the individual post.
- **Alerts**
  Based on the knowledge gained, **push notifications** can be sent to the responsible persons in order to react promptly. These can be sudden deviations or slow changes in trends.
- **Sentiment analysis**
  In order to recognize the **mood in the population**, the posts can be classified as positive, neutral and negative. In this way, problems can be identified more quickly in the various areas of city management (cf. Sect. 4.2.4).

Paris and Tel Aviv are already using this system to keep their finger on the pulse of their own citizens. The exciting question is how quickly the knowledge gained here can be transformed into action in view of the often **dominant bureaucracy in city management**.

Memory Box
Smart city is essentially about nothing less than a comprehensive connectivity of urban technical, financial and operational infrastructures with each other and—depending on the application—with the infrastructure of the citizens (smart home, smart car…).

Food for Thought
The interesting question is what the **smart cities** will look like in the future, when more and more workstations will be filled by robots and stationary retail stores will be replaced by e-commerce with robotic delivery (terrestrial or airborne).

- What kind of work will there be in the cities of the future?
- How will we be transported to which workplaces?

The **question of the future of the city** is inextricably linked with the **question of the future of the work**.

If the city, its spaces, its rhythm, its collective rituals (lunch break, after-office drinks, window shopping) were built around the organization of work and shaped by the idea and requirements of wage labor—what would it look like if this form of labor disappeared, what will public space be if it is no longer primarily concerned with transporting people to work? (Maak, 2018, p. 45):

- What would a city look like where most people work either in small units or from a home office?
- What consequences would this have for the division of the city into a public area (offices, shops, streets, means of transport, etc.) and a private area (apartments)?
- What does it mean for urban planning when work and leisure time become more and more intermingled?
- What consequences does it have if a large number of work processes can be provided on a mobile basis—if necessary not only at a fixed location, but also independent of time?
- How would a city have to be designed if only a working week of ten hours had to be organized?
- What would happen to the office buildings, their canteens and parking lots?
- What would a city look like if unconditional basic income were to prevail on a broad basis?
- What needs must such a city primarily satisfy?
- What would a city look like if online shopping no longer accounted for only 10−20%, as it does in many countries today, but 70 or 80%?

- What happens to the shopping malls and the many small and large shops within and in the catchment area of the cities?

7.4 Mobility and Transportation Sector

A large field of application for Artificial Intelligence represent the most diverse applications in the mobility and transport sector. The challenges are particularly great because the increasing **globalization of production and goods flows** is accompanied by an increase in logistics tasks. **Increased urbanization** and the triumph of e-commerce are also boosting the growth of transport services. At the same time, in many regions of the world, the existing infrastructure or infrastructure under construction can no longer withstand this volume growth. That is why **intelligent logistics solutions** are in demand in this sector. These have different, interwoven goals:

- **More efficient use of existing transport infrastructure** (roads, railways, air and sea links)
- **Economical utilization of transport capacities** (in addition to congestion avoidance or more economical equipping of means of transport)
- **Reduction of resource consumption of energy for transport** (be it oil, gas, coal, uranium, wood) and of transport capacities themselves (e.g. roads, railways, airports, car parks)
- **Reduction of emissions from means of transport** (exhaust gases, abrasion, noise, etc.).

In addition, the most diverse AI technologies are used for demand analysis and forecasting and for the optimal use of the available logistics capacities. This includes the autonomous operation of cars, buses, trucks, agricultural equipment, self-steering rail vehicles, ships, underwater vehicles and aircraft (cf. Clausen & Klingner, 2018). The **autonomously driving car** has a key position. This technology functions as a game changer and will have a lasting influence on the future of our mobility. This initially applies directly to the **development of new car purchases** (cf. Fig. 7.2).

A **low disruption scenario** can be expected if the legal framework conditions are not clarified for a long time and convincing technological solutions are lacking. These developments would be accompanied by customers' limited willingness to take risks and pay. If these braking factors can be overcome, even a **high disruption scenario** can occur. Figure7.2 simultaneously shows that the **triumphal march of the vehicles** starts with proved and conditional decisions (in the sense of support for the driver) before autonomous vehicles take over the steering wheel completely.

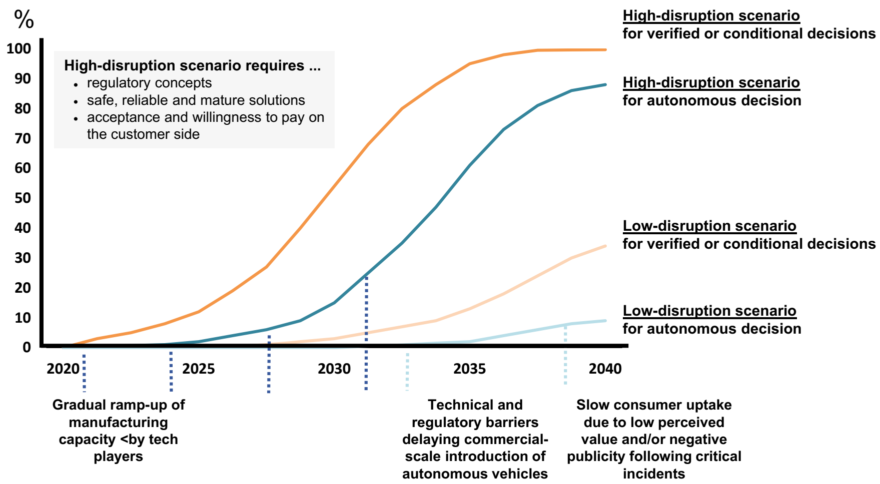

Fig. 7.2 Development of the share of autonomous vehicles in new vehicle purchases. *Source* Based on McKinsey (2016, p. 11)

Business Insider estimates predict ten million autonomously driving cars by 2020 (cf. Business Insider Intelligence, 2016). As this AI technology becomes more widespread, the **transportation as a service** (TaaS) and **mobility as a service** (MaaS) offerings will also increase. Figure7.3 shows that so far, we have used one vehicle for very different tasks. This will change massively with the availability of self-driving cars! Here, the developments of the autonomously driving vehicle complement each other with the concepts of the sharing economy—I get a specific vehicle when I need it—and only then!

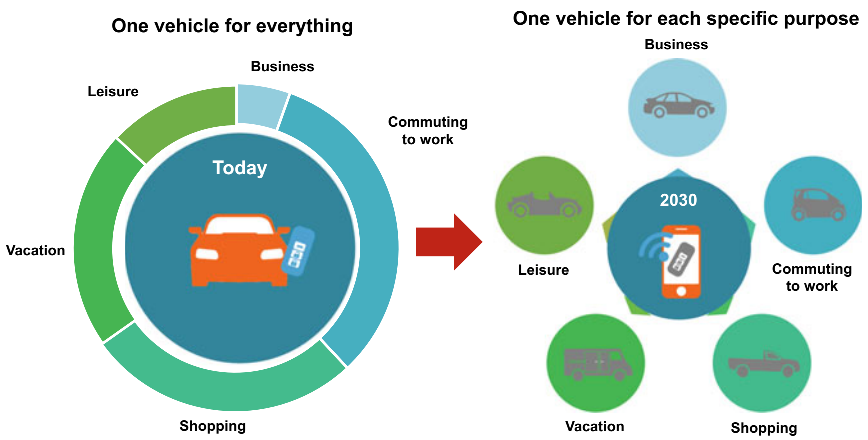

Fig. 7.3 Future use of vehicles. *Source* Adapted from McKinsey (2016, p. 8)

The **development towards an autonomous vehicle** is taking place in various stages (cf. VDA, 2018):

- **Level 0**: "**Drivers only**"
  Only a warning function is used when the vehicle leaves the lane; or the blind spot is monitored. The driver acts alone in every situation.
- **Stage 1: Assisted driving**
  A parking steering assistant and a lane keeping assistant support the driver.
- **Stage 2: Semi-automated driving**
  In certain cases, assistants are used to act independently, e.g. when parking or to provide support in traffic jams.
- **Level 3: Highly-automated driving (autonomous driving level 4)**
  Autonomous driving on the motorway and following traffic jams are possible independently.
- **Level 4: Fully-automated driving (autonomous driving level 5)**
  Autonomous driving in the city and driver-free parking are possible.

What about **user acceptance of autonomous driving** today? A total of 1,003 people in Germany were interviewed on this subject. A look at Fig. 7.4 shows that the advantage is primarily seen in congestion situations—while otherwise skepticism prevails. We can find similar results in other European countries.

Autonomously operating vehicles **enable innovative logistics solutions**. In order to achieve an intelligent link between the different vehicles in use, *Uber* has set up its own AI research department. This should contribute to optimizing the customer experience through autonomous driving by predicting arrival times more precisely and developing voice control (cf. Turakhia, 2017). In addition, **on-demand transport services** allow dynamic pricing based not only on supply and demand, but also on traffic volumes. AI-based solutions have the potential to

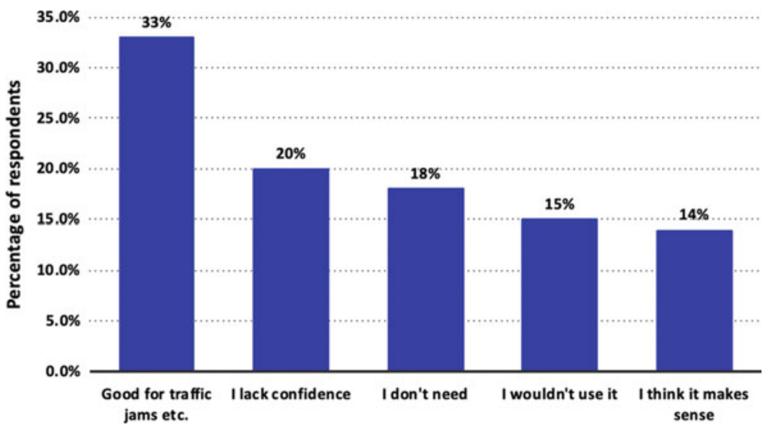

Fig. 7.4 What do you think of autonomous driving? *Source* Statista (2018, p. 40)

sustainably increase the convenience of use and accelerate a development to the mass market. In addition, the available resources can be better combined and thus used more efficiently.

However, it is not only private individuals who will change their usage behavior, but also the upstream logistics chains. In addition to **autonomously driving trucks**, other **autonomously driving means of transport** also play an important role. The latter also refers to **driverless transport vehicles**. These are not only used in intralogistics (i.e. in a factory), but also in extralogistics (outside the boundaries of a company).

The company ***DoorDash*** tries to shorten delivery times, increase efficiency and at the same time improve quality by using innovative technology. The company supplies its customers with food from restaurants. In order to achieve this goal, the deliveries were tested by robots in different cities of the USA. Based on initial experience, the *DoorDash* delivery platform was integrated directly into the robot's software with the relevant order information. The robot called ***Marble*** can now also deliver multiple orders over short distances (cf. Tang, 2017).

In addition to the people who prepare the food deliveries and, if necessary, arrange them at the destination, the robots function as **autonomous dining cars**. In the future, a **robot could become a mobile hub-and-spoke model**. A robot can pick up several orders from a single restaurant at once and transport them to a central dispatch center. There, human deliverers or robots can bring the orders to their final delivery destinations. These robots represent only a first step towards optimizing delivery logistics: With drones, autonomous vehicles and other technologies further innovative solutions are aimed (cf. Tang, 2017).

AI technologies have long been used in **aircraft technology**. Artificial Intelligence increasingly supports the pilot as an autopilot, predicts delays, corrects errors during the flight and is also involved in the predictive maintenance process (cf. Adams, 2017). Now, more and more **drones** are conquering the sky—not only in private hands. Leading e-commerce vendors like *JD* from China, *Amazon* and other tech companies like *Google* are developing drone systems to enable unmanned delivery of packages. A **drone-based delivery to commercial distribution points** is already partial in use. In addition, concepts are being planned to carry out this delivery from airships that circle over large cities as flying warehouses.

The master discipline is **delivery by drone to private households**. As early as 2016, *DHL* reported successful tests with delivery by parcel drones to a packing station in Reit im Winkl after some startup difficulties. Over a period of three months, customers could not only receive parcels by drone, but also send them. It was possible to dispatch particularly urgent medications within eight minutes. The supply of a 1,200-meter-high alpine pasture was also successfully tested. The first test flights with drones over the Rhine near Bonn were already carried out in 2013 and over the North Sea to Jüst in 2014 (cf. n.a., 2016).

In a wider **use of drones for logistics applications**, overcoming obstacles to flying in an urban environment is of great importance. In addition, legal restrictions on the use of airspace (in the case of safety-relevant facilities, e.g. near airports) and

general safety aspects must be taken into account. After all, the drones must be well protected against hacker attacks in order not to become a security risk.

Fictional reading tip Where an intensive use of drones can lead can be read in the very exciting book "*Drohne State*" by *Tom Hillenbrand*.

Summary

- The **success of smart grits** and the **penetration of smart meters** depends on the security of these networks.
- The **development of smart homes** is only slowly picking up speed. It remains to be seen whether enthusiasm for technology or skepticism about technology will dominate. There are weighty arguments for both sides.
- The development of **smart cities** is also making only slow progress.
- With **autonomous vehicles**, Artificial Intelligence has the potential to significantly reduce congestion and accidents caused by human error.
- In addition to **optimizing ground-based logistics chains**, airspace will become increasingly important for logistics tasks.
- The existing **logistics infrastructure** can be used more effectively, significantly reducing resource consumption and emissions.
- A simultaneous **increase in the volume of deliveries**—especially to private households—could reduce such effects or even overcompensate them.

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Fields of Application of Artificial Intelligence—Financial Services and Creative Sector

8

Abstract

In this chapter you will see that the financial services market is a particularly exciting field for AI. Artificial Intelligence can support workflow automation in the near future (robotic process automation). Additional important fields of application are credit scoring as well as fake and fraud detection. Robo consultants and robo advisors are increasingly used in asset management. Another interesting field of application is high-frequency trading. AI systems are used in the creative sector, too. AI-supported "new creations" are still based on recognized patterns in already existing pieces of art. Nevertheless, many creative processes can be supported by Artificial Intelligence. This kind of "new creations" of voices, photos and videos are particularly critical. The reason is that in future it will be more and more difficult to distinguish between fiction and truth due to emerging deep fakes.

8.1 Financial Services

More and more financial institutions are already using Artificial Intelligence systems. The opportunities in these industries look very promising. The **Artificial Intelligence market for financial services** is expected to grow from US-$1.3 billion in 2017 to US-$7.4 billion in 2022. This corresponds to an average annual growth rate of 40.4% (cf. Fraser, 2017). This development is fueled by a multitude of innovations and challenges in this industry. These include the further expansion of mobile banking, cyber security as well as areas of application for blockchain technology.

The international *Digital IQ Survey 2017* (cf. PWC, 2017) delivers interesting results:

R. T. Kreutzer and M. Sirrenberg, *Understanding Artificial Intelligence*, Management for Professionals, https://doi.org/10.1007/978-3-030-25271-7_8

- 52% of financial services companies surveyed stated that they were **currently making substantial investments in Artificial Intelligence**.
- 66% indicated that they **would make significant investments** in three years.
- 72% of decision-makers believe that **Artificial Intelligence will lead to significant business benefits** in the future.

Workflow automation is a first important AI field of application, also for financial service providers. Many financial institutions already use natural language processing to automate business processes. Ideally, this should not only reduce costs, but also increase customer satisfaction. As already discussed, the interests of companies and customers often diverge here.

An example of a successful implementation is provided by *Bank of America* with the virtual assistant ***Erica***. This assistant is available as an app to the bank's 25 million customers. Customers can speak directly to *Erica* or exchange text messages with her. In addition to the transfer of funds, *Erica* will also send out notifications in future as to when which payments are due. It should also motivate customers to save money or identify unusual account movements. The services are to be increasingly individualized step by step (cf. Bessant, 2018, p. 26).

JPMorgan Chase uses a **contract intelligence platform** with image recognition. This allows to check contracts and other documents in a matter of seconds. For a manual check of 12,000 credit agreements per year, 360,000 h would have to be invested. *Bank of New York Mellon* uses bots for **robotic process automation** (RPA) to increase operational efficiency. According to their own statements, this would achieve 100% **accuracy in the validation of account balancing** across five systems and an 88% **reduction in processing time** (cf. Singh, 2018).

In the **credit and insurance business**, AI systems are used to process applications faster, more accurately and more cost-effectively (cf. also Sect. 1.2). The complex standards of risk assessment must be fully taken into account. AI-supported processes can make an important contribution to ensuring accuracy and speed in billing processes. In the insurance industry, so-called **dark processing** already occurs very often. This refers to a process that is completely automated without human intervention. Since these processes take place “in the dark”, the term dark processing has become established. Such systems have another major advantage: high scalability. After all, such systems can also be used to process large amounts of data quickly.

Since 2018, the *Deutsche Familienversicherung* (German family insurance) has already been offering advice and concluding contracts via *Alexa*. Initially, this offer only applies to foreign health insurance—but further products are to follow soon (cf. Klemm, 2018, p. 34). This already shows the importance to digital personal assistants in the future.

AI systems are also increasingly being used for **credit scoring** because a large number of profile and transaction data has to be evaluated in an integrated manner. After all, the traditional credit rating today is supplemented by a lot of other data, which can be obtained from social media channels or—in real-time—from online transactions.

The fintech startup company ***GiniMachine*** uses Artificial Intelligence in this way to reduce **default rates on consumer and corporate loans** through innovative scoring models. For this purpose, the *GiniMachine* **platform** enables a comprehensive creditworthiness check. The system automatically creates, validates and implements high-performance **risk models**. *GiniMachine* requires at least 1,000 data records with a status: good (paid back) or bad (overdue). No pre-analysis or data preparation is required for the model construction itself, not even for unstructured data. In addition, detailed validation reports are continuously provided to the user. In this way, the selectivity of the model can be continuously checked. Hundreds of hypotheses can be tested within minutes. *GiniMachine* monitors the performance of the models themselves and gives an impulse when new training is required (cf. GiniMachine, 2019).

Food for Thought
The time has already come when decisions about financial transactions are made less by people than by machine "minds". We are thus becoming more and more dependent on the data (e.g. also in the social media) that we produce at the most diverse contact points in recent years. The resulting **digital shadow** can work for and against us—and in the future it will become increasingly difficult for us as customers to know which facts led to a decision.

Fake and fraud detection is an important field of Artificial Intelligence. Basically, this is about the detection and **prediction of fraudulent behavior**. The previous systems for the detection of financial fraud usually use a predefined checklist of risk factors, which are linked together in a complex set of rules. In contrast, AI systems can detect behavioral anomalies in advance and send alert messages to risk managers. By continuously feeding in information on whether the AI-based predictions were correct or incorrect, the forecast quality will continuously improve. This means that the proportion of false positives will also decrease in the long term. These are predicted risks that subsequently turned out to be wrong (cf. Singh, 2018).

The *BKA* (German Federal Criminal Police Office) is currently training AI systems so that they can extract information for criminal actions from large—and in some cases leaked—databases. The documents to be processed are so extensive that even hundreds of specialists would have to read their whole lives and still not be able to look at all the files. AI applications can perform time-consuming research tasks here (cf. Ulrich, 2018, p. 44).

In **asset management**, so-called **robo advisors** are used. This is an **algorithm-based, automated asset management system**. The management of the investment portfolio is individually tailored to each investor's individual goals and risk appetite. *Deutsche Bank* offers such digital investment advice under the name ***ROBIN*** (cf. Robin, 2019). This term stands for Robo-Invest and combines AI technologies with the knowledge of experienced portfolio managers and advanced risk management. With *ROBIN*, the investor can invest in ETFs (Exchange-Traded Funds) today. It is a special form of the classic investment funds that are traded on

the stock exchange. *ROBIN* makes a professional asset management system available for other market participants, which was previously only available to wealthy investors. For this purpose, *ROBIN* takes over all necessary investment decisions and executes them automatically. A dashboard provides the user with the following overview:

- Value of risk
- Initial investment
- Optional monthly investment contributions
- Minimum investment horizons.

In addition, a diagram shows the possible portfolio composition at the current point in time. These include liquidity, government bonds, corporate bonds, equities from industrialized countries and equities from emerging markets (cf. Singh, 2018).

With ***Wealthfront***, the client is offered a “financial co-pilot” as a **complete solution for the financial investment**. For this purpose, the offer relies on a passive investment. This means that interested investors will be offered a globally diversified portfolio of index funds. In order to maximize the return on investment, the aim is to minimize the fees incurred. On the other hand, an attempt is made to reduce the tax burden through a strategically oriented investment policy. At the same time, a portfolio is built up according to the individual risk preferences of the respective investor. If the risk profile of certain forms of investment changes on the market, this immediately leads to a shift in the portfolio (cf. Wealthfront, 2019).

The robo advisors claim to not only automatically and comfortably align the asset investment but also to orient them with the highest scientific and technological standards. *Stiftung Warentest (Finance Test,* a German consumer organization*)* and the comparison portal *Brokervergleich.de* tested the performance of various systems and came up with some sobering results (cf. Kremer, 2018, p. 31; Motte, 2018, p. 35). Only longer-term studies will show whether Artificial Intelligence can lead to sustainable performance in a dynamic market environment at relatively low costs.

Another interesting field of application for Artificial Intelligence is **high-frequency trading**, which is also referred to as automated or **algorithmic trading**. At its core is the algorithm-supported automated purchase and sale of securities. Complex AI systems allow a variety of market factors to be analysed in real-time to make investment decisions in milliseconds. Thus, global price and knowledge differences can be exploited to optimize investments. The AI-based systems make it possible to carry out hundreds of thousands or millions of transactions per day. By evaluating the results obtained, the algorithms can be continuously improved.

Here, as in all other fields of application of Artificial Intelligence, the quality of the decisions made depends on the quality and reliability of the available data. If incorrect or out-of-date data is used for investment decisions or for the credit rating, serious mistakes can result. In addition, due to the sensitivity of the processed data, data security itself must also be given the highest priority (cf. Singh, 2018).

8.2 Creative Sector

If the Creative sector is discussed separately at this point, this does not mean that no creative processes are necessary in the aforementioned areas. This section is primarily concerned with the artistic areas of our lives through which we differentiate and define ourselves as human beings.

Memory Box
As things stand today, an AI system is not actually capable of being "creative" in the human sense by creating something unprecedented. What can be achieved are **congenial re-creations** in the sense of **high-quality transmissions** (cf. Hofstadter, 2018, p. N4).

AI systems are already able to **simulate creativity** well today, so that we often can no longer perceive the difference between human creativity and AI creations. **AI-supported** "**new creations**" are based on a very specific procedure model. Again, AI algorithms attempt to recognize certain **patterns** through the evaluation of dozens, hundreds or thousands of musical compositions, images and/or texts. These patterns describe what is often referred to as the "**handwriting**" **of artists** as a specific approach to composing, painting or poetry. This "handwriting" can be recognized by algorithms and used to create "new" works based on it. The algorithms still have a link to the determined patterns.

Section 4.2.5 already described that AI systems can write texts independently. This is not about literary high achievements, but rather to provide information as quickly as possible. There are already various applications of an **AI-supported film production**. An AI application was specially developed to write a new script for a continuation of the popular sitcom *Friends* from the 90s. For this purpose, the system was fed with all old TV-series in order to recognize patterns and to link to existing strands of action (cf. The Daily Dot, 2016). A manuscript written by an AI algorithm named ***Benjamin*** provides an outlook on further developments. The seven-minute science fiction film *It's No Game* with *David Hasselhoff* was created using an AI system. The system was provided with data from *Aaron Sorkin, Baywatch, Knight Rider* and *William Shakespeare*. The result was published in 2017 on the tech portal *Ars Technica*, where it can still be seen: https://arstechnica.com/gaming/2017/04/an-ai-wrote-all-of-david-hasselhoffs-lines-in-this-demented-short-film/.

In 2018, *Lexus* had a commercial developed, supported by Artificial Intelligence. The short **campaign film** *Driven by Intuition* tells the story of a *Lexus* developer who fine-tunes a car before it leaves the factory for a crash test. The script for this spot was developed entirely by Artificial Intelligence. The AI system was fed with campaigns from car and luxury brands over the past 15 years that were recognized by *Cannes Lions* for their creative performance. In this way, the algorithms learned which content was particularly well rated and how to integrate it into a spot. In addition, "emotional intelligence" data from the video service provider ***Unruly*** was used. Based on this data, the AI system learned how to combine objects and

locations to trigger certain emotions in viewers. To ensure that the AI-created spot corresponded to the corporate design of *Lexus*, the AI system was also taught the appropriate framework conditions. The evaluation of audio, text and visual data of the *Cannes* films was done by *IBM Watson*. Based on the insights gained, British director and Oscar winner *Kevin Macdonald* was hired to film the script. The result can be seen here: https://www.youtube.com/watch?v=-iaBJ5rqOdg.

To answer the question why the AI system chose this script (keyword Explainable Artificial Intelligence), *Lexus* shot a making-of video to show the "thought processes" of the AI application. The choice of a Japanese developer for the TV spot was intended to convey the origin of the *Lexus* brand. In addition, *IBM Watson* had recognized that the use of drones in auto spots is very popular, especially when the spots are hilly, and the sea is in sight at the same time. Here, the basic features of Artificial Intelligence are again perfectly visible: recognition of patterns that lead to success (here *Cannes* awards, cf. Rondinella, 2018). The making-of film can be found here: https://www.youtube.com/watch?v=l91ehyqFca8 (cf. McKinsey, 2017 for further information on this topic).

Computer games are another field of application for Artificial Intelligence. Game developers are increasingly relying on Artificial Intelligence to find the perfect opponent for the human player. Through this, overpowering opponents can grow up for the human being. This is the case in the puzzle game *Portal 2*; the dialogs here are spoken by ***Glados***—an AI application. Such applications allow the games to adapt in their course to the respective human opponent: The AI-supported opponents recognize typical behavior patterns and can adjust their own actions accordingly. In this way, they become increasingly strong and flexible opponents, who at the same time are justified in the expectation of credible behavior on the part of the characters in the game world.

This shows the same development in the gaming environment that we have already seen with *Chess*, *Jeopardy* and *Go*. In 2017, a computer-controlled bot defeated a professional player in the online real-time strategy game *Dota 2*. This bot was developed by the organization *Open AI*, which is introduced in more detail in Sect. 11.1. The computer trained for two weeks by playing against itself again and again. The amount of data gained made it possible to win the game against a human opponent. The following further games use Artificial Intelligence systematically today (cf. Scheuch, 2018):

- ***Thief—The dark Project***
  In this game the AI opponent reacts to noises caused by the opponent.
- ***Left for dead 2***
  In this zombie game the AI opponents adapt themselves individually to the respective player and are also able to solve problems independently.
- ***Far Cry and GTA***
  Artificial Intelligence has succeeded in creating an independent world to live in, in which people behave very realistically.

- ***Fear***
  In this first-person shooter game, the AI-supported opponents coordinate with each other so that their actions appear very authentic.

Memory Box
Such a development towards increasingly powerful AI-supported online opponents must also be restricted to—human—limits. If even the professional players can no longer win against AI-supported opponents, the fun of the game is lost.

In addition, the gaming industry makes valuable contributions to the **perfection of customer experience** in the AI world. It is particularly important that services can not only be displayed digitally, but also that an online interface is created that can be used intuitively by customers and leads to relevant service offerings. This is the only way to create acceptance in the long term! An example of this is the approach taken by the startup ***Vitronity*** from Stuttgart (cf. Vitronity, 2019). They support banks in setting up a VR-supported customer journey. The founding team benefits from their gaming background in order to develop new business models from existing applications. In addition, the important integration of further technologies (here virtual reality and augmented reality) with Artificial Intelligence becomes visible again at this point.

The **US series *Westworld*** offers spectators an impressive mental game. A **futuristic amusement park** for adults was created to use human-like robots (the so-called hosts) to transcend the limits of legality and to adventure hunt, murder and rape human-like robots at will. In addition, bank robberies and gold searches are on the schedule. The firearms used have been modified in such a way that the hosts can be seriously injured and even killed; guests do not suffer any serious injuries. The very fictional plot also provides interesting information on how the linguistic development of chatbot systems in humanoid robots could look like (cf. Borcholte, 2018).

AI-supported, literary classics can be adapted in such a way that every reader receives his or her favorite version—for example of *Gone with the Wind*. A **one-to-one creation of books** would be possible. For example, if a reader wishes that *Professor Dumbledore* does not die in the book *Harry Potter and the Half-Blood Prince*, an AI application could write such a version in the future. At the non-fiction level, guidebooks could be much more responsive than today to the individual life situation of a person. Instead of a "guidebook for love relations" there would be e.g. a "guidebook for a freshly divorced woman after 11 years marriage, 36 years old, a child at the age of seven years, with house credit over US-$135.000 in New York, having a full-time job in a large bank". For this it is necessary that the future reader—on a guidebook platform—makes the relevant data available. It would then be exciting for the learning process of the AI system to learn something about the implementation of the recommendations made and the positive and negative results triggered by them through quarterly surveys, in order to further improve its advice.

In China, a volume of poetry written by the *Microsoft* chatbot ***XiaoIce*** with the beautiful title "Sunlight without windows" was published in 2017. Before the chatbot itself became creative, it was fed with the works of 519 poets. The work made it to first place in the *Amazon* China ranking. The question of whether poems can be traced back to their AI origin is a hotly debated issue among Chinese writers. A corresponding online test addressed to the readers of *Beijing News* did not lead to a clear result (cf. Hauser, 2018, p. 16).

Memory Box
Artificial Intelligence does not yet master complex creative processes. Their "creations" are based on imitation and variations, whereby primarily semi-original results can be achieved.

In **music**, AI applications can already compose autonomously—e.g. based on the evaluation of **masterpieces** by *Bach, Beethoven* or *Chopin*. A so-called **style transfer** is used for this. This is the re-composition of music in the style of the previously analysed music. In the course of this style transfer, the algorithms are fed with the corresponding works of the artists in order to recognize their respective styles and to use it as a base for the composition of "new" pieces or entire "new" sympathies. Again, the "new" works represent nothing more than a new combination of the patterns already recognized from the existing works.

Exciting fields of application for an AI-generated music are less with the great masters than with the **creation of utility music**. In order to compose music for elevators, shopping centers, aircrafts, video games or simple TV series at low cost, appropriate systems can be used. Startups such as Amper Music (cf. 2019) and Jukedeck (cf. 2019) apply Artificial Intelligence to produce music for computer games, videos and advertising. With *Jukedeck* any layman can try his or her hand as a composer. All you have to do is enter the desired style (such as pop, rock or jazz). In addition, the desired length of the piece as well as a possible timing for highlights etc. must be specified. After a few seconds, the software makes the finished composition available for free download (cf. Jukedeck, 2019).

The music artist *Benoit Carré* alias *SKYGGE* already produced the pop album *Hello World* with the AI software ***Flow Machines***—an EU research project. The artist was not interested in cheaply produced background music; rather, he wanted to test the possibilities of artistic expression through Artificial Intelligence. The basis for the "new creation" were old folk melodies and jazz recordings. The song *In the House of Poetry* was created on the basis of this basic material. The text was written and sung by *Kyrie Kristmanson* based on *Hans Christian Andersen*'s fairy tale *The Shadow*. In the second part of the song, the voice is generated by *Flow Machines*. According to *Carré*, the greatest challenge in the creative process lies in the structuring of the AI-created music components as well as in their sequences and transitions. Only elegant connections can turn a song into a successful song (cf. Heuberger, 2018).

When **creating voices**, there are still other fields of application to think about. The ***VoCo*** software program from *Adobe* is able to imitate a human voice almost perfectly using just a few sound examples. Perhaps soon, the familiar voice of *Siri* will no longer illuminate us with her tips, but instead the voice of our beloved (cf. Volland, 2018, p. 43).

In the **visual arts**, too, there are numerous experimental approaches to use Artificial Intelligence. As in music, a **style transfer** is also applied here. This is about the re-composition of images in the style of other images. For example, masterpieces by *Munch, Picasso, Rembrandt* or *Van Gogh* can be "fed" into the AI system. For example, a mountain landscape can be painted in the style of *Edvard Munch*, according to an AI system. Here it becomes very clear how patterns recognized by Artificial Intelligence (colors, lines) are used for the "new creation".

An AI application called ***The next Rembrandt*** has evaluated 15 terabytes of information from the famous painter to learn his painting style. Among them were 346 original works, which were transferred to the system in high-resolution 3D scans. With this knowledge, the system managed to create a painting of a man with a hat and a white collar with the help of a 3D printer in 2016, which looks overwhelmingly real. Even the *Rembrandt* expert and art historian *Gary Schwartz* admitted that the developers had succeeded in identifying those qualities that would turn a *Rembrandt* into a *Rembrandt* (cf. Brown, 2016).

In 2018 a **painting of Artificial Intelligence** was auctioned for the first time. The *Edmond de Belamy* work was sold at the auction house *Christie's* in New York for US-$432,500. The image was developed on the basis of a data set of 15,000 real portraits. The signature of the work is exciting: min G max D Ex + Ez (log(1 − D (G(z)))—as an identifier for the AI algorithm used.

At the ***Ars Electronica*** 2017 the motto was "AI Artificial Intelligence—The Other I". AI systems for the "art process" were presented there. In the installation *A3 K3* by *Dragan Ilić*, a *Kuka* robot drew a portrait with the help of spectators. The link between man and computer was a brain computer interface (BCI). A further installation entitled *Wind of Linz*: *Data Painting* follows a different AI approach for the visual arts. For this purpose, the invisible wind currents of the city Linz were recorded and processed into a data painting.

Food for Thought

Can the **creations of Artificial Intelligence be distinguished from human art**? A research team led by Prof. *Ahmed Elgammal* challenged the quality of AI-created artworks with a test. A jury consisting of people should evaluate works from different art movements under characteristics such as aesthetics and stylistic quality, without knowing the respective artist.

It turned out that the work of AI systems was often rated better than that of human-made systems. How was that possible? Behind this are two **logics of Artificial Intelligence**. On the one hand, it attempts in various works to take up the conspicuous—and thus the seemingly proven—in a new form. On the other hand, it tries to create art by combining already established patterns to create new patterns

(cf. Voon, 2017). It is almost inevitable that these will come closer to the "human ideals".

In the ***Prisma*** app application, the digital style transfer, which was mentioned several times before, is very simple. You upload a photo as shown in Fig. 8.1. Then you choose one of many different styles (e.g. *Andy Warhol* or *Piet Mondrian*). Within a few seconds it will be transferred to the uploaded photo. Just think how much time a graphic designer would have to spend to deliver similar performance! Here, it should be pointed out that this app belongs to the Russian e-mail provider *Mail.ru* and that it comprehensively accesses user data (cf. Prophoto, 2019).

The creative processing of digital image material goes one step further. It reaches a new climax of the **photomontage**. Using the exact calculation of pixels, familiar faces can be inserted into all possible settings. In addition to the positive effects of new design options, this initiative also entails considerable risks. In the future, the content of any photo in social media may be questioned, as the alleged evidence photo of a crime may be a fake. These **creative counterfeits** pose new challenges not only to the judiciary, but also to enlightened humanity in terms of the credibility of pictorial material. These possibilities for counterfeiting can also be transferred to videos, as a video by *BBC News* impressively shows with a speech by *Barack Obama*: https://www.youtube.com/watch?v=AmUC4m6w1wo (cf. BBC News, 2017).

The AI system used to copy *Barack Obama* was fed with 13 h of video footage of the former US president. This allowed it to accurately capture the movement of its mouth and apply it to the input of a new speech. With such an application, any interested user can hear their own words from *Barack Obama*'s mouth. The

Fig. 8.1 Creation of own artworks by the app *Prisma* (Authors' own figure)

possibility of such counterfeits is possible for any person of whom there is enough digital image material available. The freely available software ***FakeApp*** makes it possible. What does the editorial staff of *Chip* magazine call it "beautiful"? "With the free program FakeApp you can create so-called deep fakes and exchange deceptively real faces in videos. … In a film, for example, the face of the stuntman can be subsequently exchanged for the face of the actor. To try it out for yourself, you don't have to go to Hollywood, you just have to install the free tool FakeApp" (Chip, 2018).

The AI system ***TensorFlow*** can also be used for digital face transfer. This was used by a programmer to incorporate the facial features of the actress *Gal Gadot* into a porn video. By the way, TensorFlow (2019) is an open source machine learning framework for everyone developed by *Google*.

Food for Thought

Fake news 2.0: The possibilities of falsifying photos and videos will make it harder and harder to track down "truths". Since images leave a particularly lasting impression on viewers, the danger of a comprehensive manipulation of people and entire societies should not be underestimated.

The exciting question is therefore: What effects are to be expected if every event can be set visually in scene at any time—by whomever—regardless of whether it has ever taken place like this or not?

For these counterfeits the technical term **deep fakes** was coined.

The artist collective *YQP* with the Berlin painter *Roman Lipski* shows another example of the interaction between Artificial Intelligence and the creative. First, a software was programmed that serves *Lipski* as an **Artificial Intelligent muse**. This first analyses the painter's pictures with regard to dimensions such as composition, colors, style, brightness, brushwork and other elements that we are not aware of. This is therefore also about pattern recognition!

Using the data generated in this way, the AI system then creates new images that *Lipski* uses as inspiration. When painting, the artist picks up various recognized elements and processes them in his works. The new images are fed back to the AIR (Artificial Intelligence novel). Again, in this application, it is not the AI system that creates something new, but only the cooperation between human and machine leads to a new result.

It becomes clear that a large number of artists deal constructively with the possibilities of Artificial Intelligence (cf. Volland, 2018, p. 64). Many see their use as enrichment and are open to new technologies in order to make new artistic approaches possible, as the camera once did.

Artificial Intelligence is not yet in a position to really act creatively on its own. Again and again, it is first about the recognition of existing patterns in order to develop "own creations" based on them. At the same time, Artificial Intelligence penetrates into areas that we humans regard as specific to our species—as that which distinguishes us from animals and machines. Nevertheless, many fears that AI systems will soon take over the creative part are unfounded, especially in the artistic field. Today, such systems can only support creative processes.

Food for Thought
We should ask ourselves whether Artificial Intelligence cannot or should not become a powerful partner of the creative industry. AI systems can recognize what kind of scenes people like most in movies, what kind of music is most appreciated, and what kind of images we like. The result—whether loved or despised—would be **art-on-demand**.

In the future we might only tell an AI system how many square meters and rooms our house has, how many people of which age and sex it should accommodate and what hobbies they have. In addition, we can still define what it may cost and a ready to implement and well-calculated creative planning for interior decoration is created, which is oriented to these inputs. The necessary artworks and utility furniture can—if you like it—be produced by different 3D printers. The result: individualization in perfection!

In addition to the creation of pictures and artworks, Artificial Intelligence can also be used to **reconstruct destroyed art treasures and cultural assets**. The *Fraunhofer Institute for Production Systems and Design Technology* in Berlin developed a software called ***ePuzzler***. It has already made an important contribution to the production of readable files from approximately 600 million snippets of the Stasi (The Ministry for State Security) documents which were destroyed in the last days of GDR (German Democratic Republic) regime.

In a broader sense, the **translation programs** already mentioned in chapter 1 can also be assigned to the creative sector. After all, a good translator should not simply translate word for word, but take into account the aesthetics of the language, the melody of the language and, if necessary, the meaning of the second and third semantic level. While the *DeepL* translation program in particular already performs well (especially in German-English translations), other programs fail because of more complex languages. Fig 8.2 shows an example of this.

It is to be expected that AI-supported translations will become better and better in the future for both written and spoken language. This requires that a comprehensive background and context knowledge flows into the translation process if

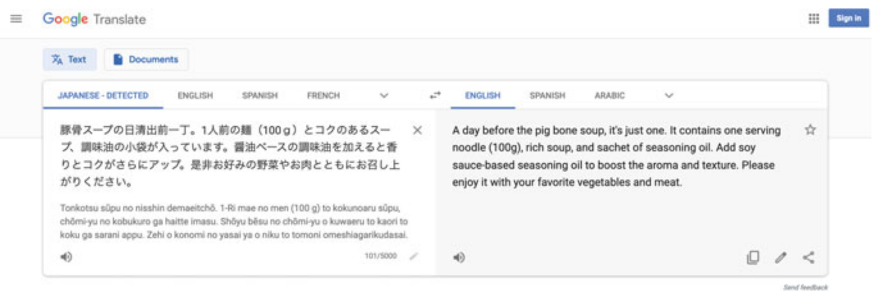

Fig. 8.2 Translation of a noodle product description on a Japanese packaging with the *Google* translator (Authors' own figure)

texts are to be translated not only “word for word”, but “true to content”. Very good translations incorporate many emotional decisions if the core content is to be fully translated into another language (cf. Hofstadter, 2018, p. N4).

Summary

- The **financial services market** is a **particularly exciting field for AI** because the consequences of right and wrong decisions can often be determined very quickly.
- As in many other industries, Artificial Intelligence can support **workflow automation** in the near future. This is referred to as **robotic process automation**.
- An important field of application is **credit scoring** in order to achieve more reliable results.
- In addition, AI systems can be used for **fake and fraud detection**.
- AI deployment is already well advanced in **asset management**. **Robo consultants** and **robo advisors** are increasingly being used here.
- Another interesting field of application is **high-frequency trading**.
- AI systems today are not yet able to be independently creative. With **AI-supported “new creations”**, the AI algorithms are still based on recognized patterns in order to recombine them afterwards.
- With this approach, many **creative processes can be supported by Artificial Intelligence**. This is the case with films, books, music and paintings.
- Particularly critical is the “new creation” of voices, photos and videos. In the future it will be more and more difficult to distinguish between fiction and truth due to emerging **deep fakes**, because **AI-based counterfeits** will hardly be recognizable. We believe that this poses a major threat to democracies.
- **AI-based translation systems** will soon take on many classic interpreting tasks —for texts and spoken language alike.

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Fields of Application of Artificial Intelligence—Security Sector and Military Sector

9

Abstract

In this chapter you will see that face recognition plays a central role in many security applications. In China it is even used to install a huge social credit system to control the whole population. Predictive policing tries to anticipate crimes in order to avoid them or to catch the perpetrators red-handed. Huge "progress" with Artificial Intelligence is also achieved in the military sector. Billions flow into the development of AI systems there. The greatest risks of Artificial Intelligence are associated with the various forms of combat robots, because these will massively shift the "rules of the game" in armed conflicts.

9.1 Security Sector and Social Scoring

As the fields of application of Artificial Intelligence discussed so far have already made clear, **face recognition** is of great importance. A wide range of applications is also emerging in the field of safety. The Chinese company ***Face++ Cognitive Services*** has developed a platform that can be used to integrate image recognition into various applications. Simple and powerful APIs (interfaces for application programmers) and SDKs (software development kits) make the corresponding functionality available to interested companies. Both, free and premium options are offered for this purpose (the latter as a pay-as-you-go variant; cf. Face++, 2019).

Face++ allows different **fields of application** for identity verification. It can be checked whether a user is actually present. In addition, it can be verified whether it is a living user. In an app, he or she is asked to conduct certain movements that a small face in the app. A typical **service flow with *Face++*** looks like this (cf. Face++, 2019):

- **Data collection**—e.g. via SDK, mobile/desktop device, *WeChat*-app
- **Detection**—speech recognition verification, lip reading verification, liveness detection

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- **Face comparing**
- **Result**—verification succeeded/failed.

The bandwidth of the *Face++* facial recognition software ranges from **authorized payment** to **access control in buildings** to **checking the legitimacy of a driver** (cf. Face++, 2019; Knight, 2017). All this is already possible in China today, because there are no (comprehensive) regulations to prevent the corresponding use of data.

Memory Box
Face recognition not only has the potential to bring new technology-based services to life. It can also help to prevent and solve crimes.

A particularly "exciting" link between AI applications can be found in China. A **social scoring system** is currently being introduced there, with which the Chinese state would like to completely monitor and evaluate all its "subjects". The basis for this is the "Planning Outline for the Construction of a Social Credit System (2014–2020)", which was already adopted by the State Council of the People's Republic of China in June 2014. Since 2017, a pilot project has been running in Rongcheng with a population of one million. The system is to be implemented for all Chinese citizens by 2020. The key points focus on the following contents (cf. Böge, 2018, p. 3; DDV, 2018; Kreutzer, 2018):

- Sincerity in government affairs (appropriate political behavior)
- Commercial integrity/creditworthiness
- Social integrity
- Judicial integrity.

For this purpose, all relevant **data sources** in China are accessed. This initially includes **video surveillance** in the cities, which is being massively expanded from almost 200 million to up to 570 million cameras. That would be more than one camera for every three citizens. This massive use of cameras in public spaces—combined with powerful facial recognition—makes it possible to detect legally compliant behavior in public spaces in real-time. Whoever crosses the street in red is identified by face recognition—and sometimes immediately "denounced" on a digital screen with photo, name and other information. This visibility in the public space remains until the fine is paid.

In addition, the Chinese state accesses ***WeChat***'s information, which is generated by more than one billion users every day. The further online use (shopping, searching, activities in social media) is also evaluated. This includes the use of the Chinese search engine ***Baidu*** or shopping at ***Alibaba*** or ***JD.com***. Companies in China are also supporting the development of the system by passing on personal data about their own employees. In order to cope with these data volumes, **supercomputers** are to be used in at least five of the largest Chinese cities to evaluate, among other things, the facial recognition of live transmissions from traffic surveillance cameras as well as from cameras of ATMs and smartphones in a single system (cf. Sensetime, 2018).

The concept is based on a **scoring procedure** and functions analogously to the usual credit scoring—but in China, due to the gigantic data sources, AI algorithms are used for evaluation. The basic principle works as follows:

- Each citizen starts with a **credit of 1,000 points**.
- **Extra points** are awarded to those who show charity, do their job well and are socially committed. This also includes taking appropriate care of one's own parents. Buying healthy food and visiting museums generate further points.
- The person who disregards the law, takes part in fights or causes complaints from customers suffers a **deduction of points**. Critical comments on government actions and the use of pornographic websites also lead to the deduction of points.

Anyone who has achieved a **high score** benefits from the following services:

- Access to bank loans
- Possibility to buy national and international train and flight tickets
- Access to attractive jobs (incl. promotion)
- Access to attractive residences and buildings
- Preferential admission at good schools (also for the children of the person concerned)
- Easier partner search (e.g. at the dating platform *Baihe*).

If you have a **low score**, you feel the full hardness of the political system:

- Reduction of financial aid
- No admission to management/leadership tasks up to job loss
- Difficulties to find houses and flats for rent or purchase
- Refusal to issue visas
- No access to national and international train and flight tickets
- No access to good schools and universities (even for one's own children)
- Reducing the available Internet speed
- Exclusion from public tenders
- Possibly even higher taxes.

Food for Thought

You could be cynical: The social credit system in China is **gamification at the highest level**!

However, this is not a game, it is bitter seriousness!

This also includes the fact that the Chinese social scoring system is significantly **more transparent** than our credit scoring. With the ***Credit-Sesame*-App** everyone can monitor their own credit score. Authorities, tour operators, employers, apartment and car rental companies as well as dating platforms can also access this data.

The **goals of the Chinese government** can be described in a few words. They want to reward good behavior by citizens and encourage them to stay out of trouble. Now, every citizen has it in his or her own hands to shape his or her own status positively. The subject of the ongoing tests is how the further development will take place. However, it is already clear that the system should become complete in order to ensure "**socially acceptable behavior**" **in the whole Chinese society**! It is also exciting with what equanimity the Chinese citizens look forward to these developments. Perhaps this equanimity is already a result of the feared negative points in critical comments.

There is no lack of **criticism of social scoring**—especially from commentators outside China. The first interesting question is: What is the basis for the plus and minus points? The decision is made by a small group of people—with direct and indirect effects on millions. You have to wonder on which value framework the algorithms work used in AI applications. All in all, there is an enormous state-imposed **obligation to conform**, which runs counter to the diversity propagated in (most) Western democracies. Thus, an old Chinese proverb gains new relevance: The nail that stands out is hammered in. Because now every single Chinese is **kept in leading-strings of the state** and is only "rewarded" if he or she follows its respective norms—however meaningful they may be in the eyes of the individual! We would not even want to imagine if such a comprehensive screening system of one's own population would be hacked.

Already today, facial recognition software is used to **capture crimes in real-time** and **search for criminals in real-time**. The crime rate in Shanghai, where video surveillance in public spaces is already very advanced, has decreased significantly. Figure 9.1 shows an example of what knowledge can be gained with **motion profiles**. There are no limits to imagine many further fields of application that China can open up with the analysis of many millions of facial profiles in real-time.

Food for Thought

Even if we certainly don't want to see the same kind of monitoring of our entire life in our country, China and the (state-owned) companies operating there have a data pool that is really worth its weight in gold for the **development of Artificial Intelligence**!

We will encounter the results achieved sooner rather than later on the world market—whether we like it or not!

In Western countries, Artificial Intelligence is also used in the field of security. A prominent example of this is **predictive policing** or **predictive analytics for police work**. The use of algorithms in expert systems is intended to predict when and where which type of crime is most likely to occur (cf. Fig. 9.2).

In the course of predictive policing, data from **past crimes** are evaluated because criminals often follow **predictable patterns** in their actions. These relate to the scene and time of the crime, the nature of the crime and the routes used to reach the scene. This is why it is also called the **near-repeat theory**. It means that burglars

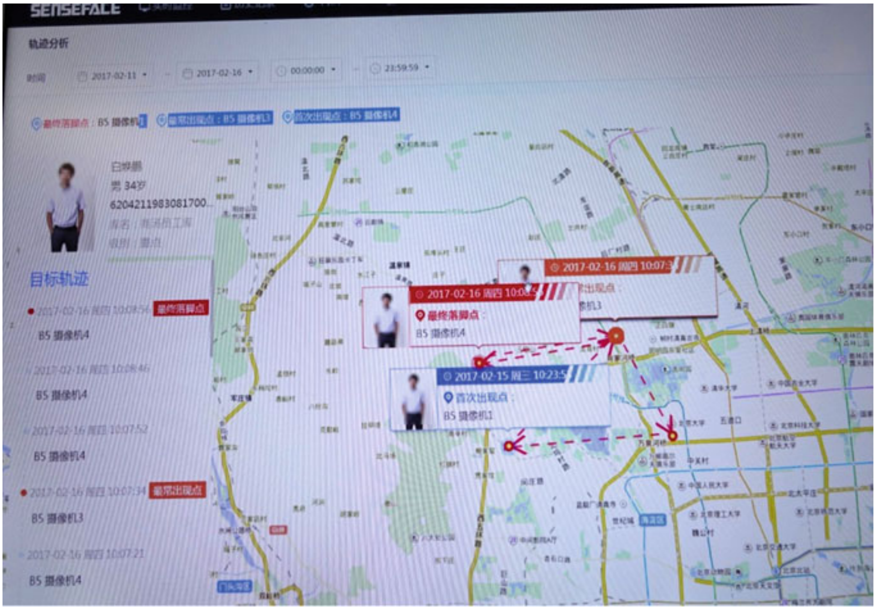

Fig. 9.1 Findings about motion profiles through *Sensetime* (Authors' own figure)

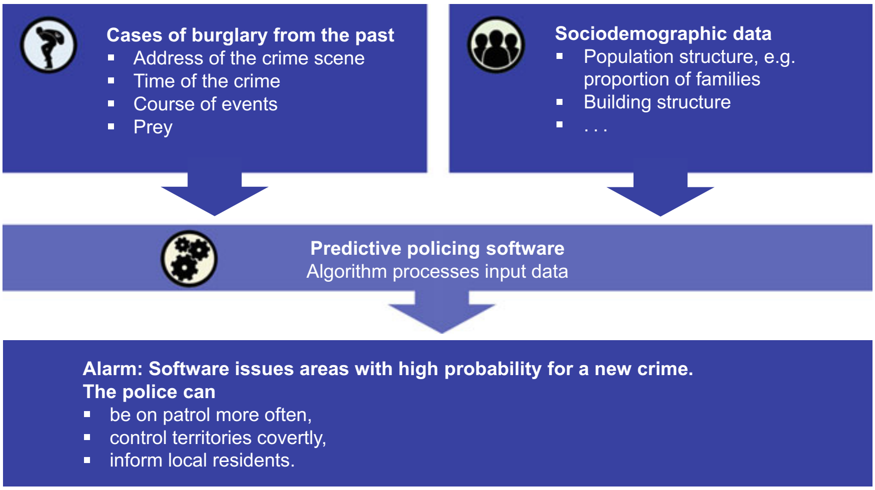

Fig. 9.2 Functionality of predictive policing. *Source* Adapted from Diehl and Kartheuser (2018)

often return to the previously afflicted area after a short time and strike again. In addition, the police often applies a **rational choice approach**. It is assumed that a criminal carries out a cost-benefit calculation before committing a crime and asks him- or herself the following questions (cf. Diehl & Kartheuser, 2018):

- How many police officers are on the move in a given area at a given time?
- What's my risk of getting caught there?
- How much could my profit be?

Based on these answers, police forces may be increasingly on the move at the identified locations and within the predicted period of time. These can either act as a deterrent or catch perpetrators in the act. It remains to be seen to what extent such concepts will affect crime rates.

9.2 Military Sector

Just for the sake of completeness, here is a brief look at the **use of Artificial Intelligence in weapons technology**. Countries such as China, Great Britain, Israel, Russia, South Korea and the USA are investing billions in this area in order to make AI technology usable for their own military. If serious **threats to humanity are to be expected from Artificial Intelligence**, this is most likely to be the case in this area. The **use of Artificial Intelligence in the military field** can be seen in the following forms, which cannot be represented without overlapping:

- **Flying drones**
  These drones can be used for **automated data and image analysis**. A large amount of data can be processed in real-time and used for decision support. If the drone makes independent decisions about attacks, it becomes a **combat robot**. A special risk is associated with so-called **micro drones**. These can attack pre-defined targets in swarms of drones, configured as combat robots. The drones coordinate themselves autonomously—and can hardly be fought by classic air defense systems. If these are equipped with a face recognition software, one can easily imagine the effect.
- **Unmanned submarines**
  U-boat drones represent a special danger for the "equal weight of terror" with regard to the submarine fleets of the great military powers. The classic submarine fleets can be spied out by cheaper autonomous submarines, so that the fleets lose their deterrent effect. With appropriate armament, the submarine drones also become **combat robots** when the use of weapons is decided autonomously and no one is involved in the decision-making chain anymore.
- **Combat robots** (also lethal autonomous weapon systems)
  On the one hand, these are **permanently installed systems** that act autonomously to ward off attacks. They are already used today to protect military and civil facilities (e.g. dams, nuclear facilities), borders (e.g. between South and North Korea) and on warships. On the other hand, combat robots—as already shown—are also used **mobile in the form of flying and diving drones**. In addition, such **combat robots can move on the land** by using wheels, chains or legs.

- **(Partially) autonomous assistants**
  Such assistants are used to **clear mines** and **defuse bombs**. They can also help to **evacuate injured people from battle zones**, **deliver supplies** or **explore caves**. The development of such (partially) autonomous assistants has received a major boost by the nuclear catastrophe of Fukushima in 2011. The area is still heavily contaminated and inaccessible to humans in many areas. Therefore, certain clean-up tasks can still only be carried out by robots. However, the radiation is not harmless for robots either. Thus, both the lens of the camera and the read-write memory can be damaged by the radiation. The stable and above all durable robots required for this operation for the way through the debris were initially not available in Japan. In contrast, the USA—also driven by the dangerous operation in Afghanistan and Iraq—had already invested many millions of US-$ in the development of such robots in the past (cf. Pluta, 2011).

Here are a few examples of this kind of robots. The ground robot ***Hector*** (**H**eterogeneous **C**ooperating **T**eam **o**f **R**obots) moves on caterpillars and is equipped with a gripper arm, a 360-degree camera and a laser scanner. It moves semi-autonomously even on rough terrain and can create 3D models of the area of operation (cf. Hector, 2019). The robot **Centauro** can use various tools with its human-like hands. For this purpose, it is controlled from a safe distance by a person wearing a full-body suit, a so-called exoskeleton (cf. Sect. 2.5). The movements performed by humans are reproduced one-to-one by the robot in real-time. This robot is also equipped with a powerful computer, cameras and 3D laser scanners (cf. Centauro, 2019).

The worldwide arms race is accelerated by the advance of Artificial Intelligence. This is rather kept hidden, because the "usual suspects" do not like to be looked into the cards (cf. von Hammerstein & Rosenbach, 2018; Herbermann, 2018; Scharre, 2018).

From the propagandists' point of view, the **advantages of using AI for armaments** are very convincing:

- AI-supported weapon systems can evaluate large amounts of **data in real-time**, identify and prioritize targets and, if necessary, attack autonomously.
- In combination with **face recognition**, attacks can be person-related.
- Through the use of autonomous weapons, human losses can be reduced on the side of the attackers and, if necessary, through more **targeted action** also on the side of the attacked.
- AI-based decision systems are independent of **fatigue, emotional sensitivities and the attention of human actors.**

Food for Thought
The ever more convincing interplay of Artificial Intelligence with robotics will produce ever more sophisticated combat machines. An exciting question is: If road traffic can be made safer from human misconduct by autonomous driving, can the use of autonomous weapon systems make wars—a semantic contradiction—more humane?

The **risks associated with the use of AI in military equipment** are also serious:

- A central question is whether the **decision-making principles of international law** and **basic human rights** can be "firmly" programmed into combat robots. This includes the binding protection of civilians and wounded soldiers under international law. Will image recognition be so good as to correctly recognize these specially protected persons in combat operations?
- Autonomous weapon systems can act without human influence and consequently **without human control** and can also make erroneous decisions (just like humans do). The question arises which decision parameters and/or ethical principles are programmed into the robots—and whether these can develop independently through machine learning (in whichever direction).
- As with non-military applications, the **algorithms** can also be **manipulated** (often difficult to understand). In the worst case, these manipulations are only detected after attacks based on them.
- Autonomous use is particularly critical if **different data are taken into account in real use** than in the training phase. Here, it is not foreseeable how Artificial Intelligence will react autonomously.
- The **dehumanization of warlike conflicts** can reduce the inhibition threshold for such actions, because the politicians no longer have to justify human losses on their own side during fights to their voters.
- The use of killer robots can cause **armed conflicts to degenerate into endless wars** because the technical systems do not become tired.
- It becomes particularly dangerous when the **political or military leadership loses control of autonomous weapons systems** and makes them "independent"—with unforeseeable consequences.
- Also unresolved is the question of **how war crimes should be prosecuted** if they are committed by autonomous weapons systems.
- Easily deployable **AI weapon systems** can cause devastating damage **in the hands of terrorist organizations**.

Fictional film tip
The ethical dilemma of the military use of drones is shown very well in the thriller "*Eye in the Sky*".

In order to set limits to critical developments, nearly 4,000 scientists, engineers and companies involved in Artificial Intelligence have documented in writing that they do not "participate in the development, manufacture, trade and use of lethal autonomous weapons". This can help to distinguish between acceptable and unacceptable AI application areas (cf. von Hammerstein & Rosenbach, 2018, p. 35).

But a convincing global solution is not in sight. On one side, 26 countries demand a **ban on killer robots** ("Campaign to Stop Killer Robots"). But as long as states like Israel, Russia and the USA are against it, the **AI arms race** will continue. And not for the good of mankind.

Summary

- **Face recognition** plays a central role in various security applications.
- In China, the **social credit system** allows us to experience first-hand the evaluation possibilities that face recognition creates in conjunction with AI-driven big data analyses.
- **Predictive policing** tries to anticipate crimes in order to avoid them or to catch the perpetrators red-handed.
- Today, **billions flow into the development of AI systems for military use**.
- These **developments take place largely in secret** and can hardly be controlled.
- The **greatest risks of Artificial Intelligence** are associated with the various forms of **combat robots**, because these will massively shift the "rules of the game" in armed conflicts.

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10 AI Challenge—How Artificial Intelligence Can Be Anchored in a Company

Abstract

In this chapter you will see that the 3-horizon model provides you with an important tool for checking the status quo of AI use in your company. Based on this you can formulate concrete tasks to initiate activities at horizon-2 and -3 levels in order to identify the strategic potential of Artificial Intelligence for your company. The presented AI maturity map provides you with a very helpful tool to analyse your AI maturity. Beside the AI basics you also focus on fields of application of Artificial Intelligence in your company. The results of the AI maturity map are the starting point for your AI journey. You will find orientation points, clear guidelines and helpful instruments to develop an AI journey for you company. You will see what is necessary to master the challenge successfully.

10.1 3-Horizon Model as a Framework for Orientation

The AI application examples discussed before show enormous strategic development potential across all industries. Here—for a limited time—an exciting **strategic window of opportunity** is open for the exploitation of new market opportunities. This should be used if you, as an established provider, do not want to be overwhelmed by AI newcomers. The aim is to systematically check the relevance of the **internal AI fields of action**. For this, it is indispensable that you are aware of the consequences of the respective change.

For this you can use the **3-horizon model** (cf. Fig. 10.1; Baghai, Coley, & White, 2000, pp. 5–17; Blank, 2015; Kreutzer, Neugebauer, & Pattloch, 2017, p. 77f.; Kreutzer, 2019, pp. 78–85). A comprehensive AI integration into products, services, processes and possibly entire business models requires on the one hand a strategic change in top management. On the other hand, a comprehensive knowledge of AI in the organization is necessary. In addition, certain frame works must be created in order to achieve success through Artificial Intelligence. Using the

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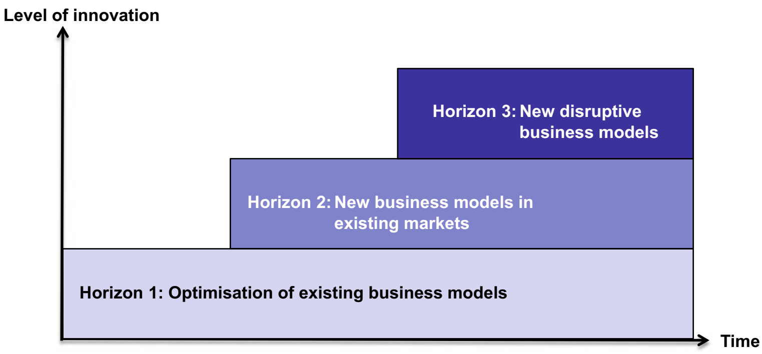

Fig. 10.1 Basic concept of the 3-horizon model. *Source* Adapted from Baghai et al., (2000, p. 5) and Blank (2015)

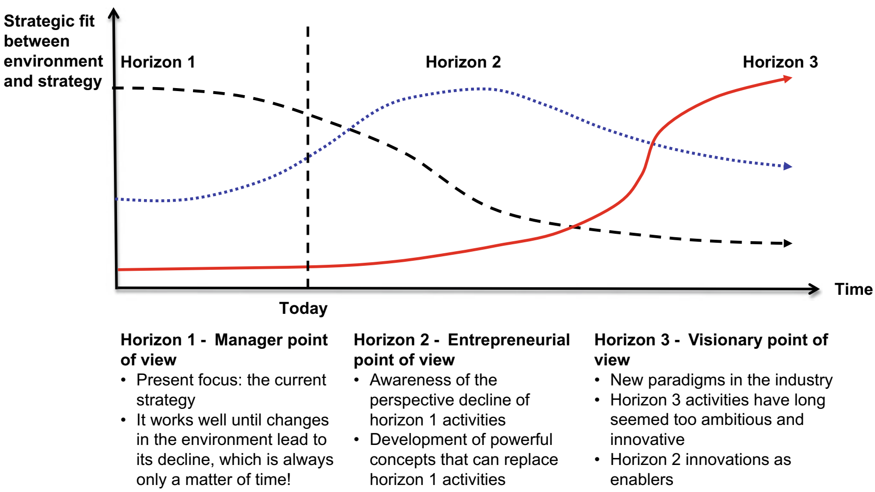

Fig. 10.2 3-horizon model for strategic analysis of AI integration (Authors' own figure)

3-horizon model, you can check to what extent AI activities are already integrated in your company—or not.

The relevant contents of the business models located on different horizons are as follows (cf. Fig. 10.2):

- **Horizon-1 business models**
  Horizon-1 business models describe the current status of a company. The existing business model is mapped and executed. The focus is on the generated revenues and cash flows. Last but not least, these are also a prerequisite for financing AI-related innovation activities at all. This core business is to be expanded and/or defended at horizon-1 level if necessary. In these (often mature) business models,

incremental improvements to processes, products and/or services must be made through the selective integration of Artificial Intelligence in order to support the growth of the established business model and secure its profitability.

- **Horizon-2 business models**
  The horizon-2 level examines which business model innovations can support the activities on the horizon-1 level. New business model initiatives that emerge from this process are often built up through substantial investment. These business models can already generate initial returns, although their business peak will often not be reached within the next four to five years. Here, a decision can be made on the use of AI that goes beyond incremental optimizations.
- **Horizon-3 business models**
  The horizon-3 business models are highly innovative (often also disruptive) and represent approaches for completely new business logic, which only become possible through AI concepts. These include predictive maintenance, predictive policing and the use of virtual personal assistants). In order to develop such business models, an in-depth analysis of individual company capabilities or customer groups may be necessary (cf. Kreutzer, 2019). This analysis goes far beyond the previous day-to-day business. On the horizon-3 level, strategic options for disruptive change are researched and ideas are transformed into concrete models; Artificial Intelligence plays a special role here.

The 3-horizon model shows the different ranges of **business model innovations**. Horizon-1 business models represent existing business logic whose execution is the focus of the existing organization and for which **incremental optimizations** are particularly relevant. This can be the improvement of the customer service through an increased use of AI in the service center. Or an AI-supported marketing automation is introduced in the CRM system in order to accelerate and individualize the customer service of an e-commerce company. Here, the level of innovation remains relatively low. On this horizon, you only improve parts of the existing business model. In this way you can secure and/or expand existing competitive advantages. In addition, you need to analyse whether your company is simultaneously working on horizon-2 and horizon-3 business models. The emphasis is on simultaneous!

Memory Box
The 3-horizon model draws your attention to a special strategic challenge. While the day-to-day business is handled on the horizon-1 level, your company must be active on the horizon-2 and -3 levels in parallel in order to successfully shape the future.

Therefore, the term **ambidexterity** became naturalized in the management language. It is simply a matter of mastering day-to-day business today and not losing sight of the future on horizons 2 and 3. Day-to-day business is about **exploitation** in the sense of exploiting the potential that has already been processed. Horizons 2 and 3 focus on **exploration** in the sense of exploring new business

areas. After all, the digital age is leading to the increasingly rapid emergence and disappearance of business models. Artificial Intelligence is an additional accelerator for this purpose.

Summary

- The 3-horizon model provides you with an important tool for checking the **status quo of AI use in your company**.
- You can also formulate concrete tasks to **initiate activities at horizon-2 and -3 levels** in order to identify the strategic potential of Artificial Intelligence for your company as early as possible.
- If you don't give the **impetus for the AI journey** in time, you won't have to leave the market today and tomorrow, but in many industries, you will certainly have to leave it the day after tomorrow.

10.2 Recording the AI Maturity of Your Own Company

The starting point of every AI strategy is a clean **location determination**, even if the results do not trigger enthusiasm. The **AI maturity map** shown in Fig. 10.3 is used for this purpose. A distinction is made between the AI basics and the AI fields of application. The **AI basics** must be analysed for all companies within the four dimensions mentioned. The relevant **AI fields of application** must be defined enterprise-specifically. These can—as in this case—include the areas of customer service, marketing/sales, service delivery and production. Depending on the focus of the company, this may also include the maintenance sector, human resources or

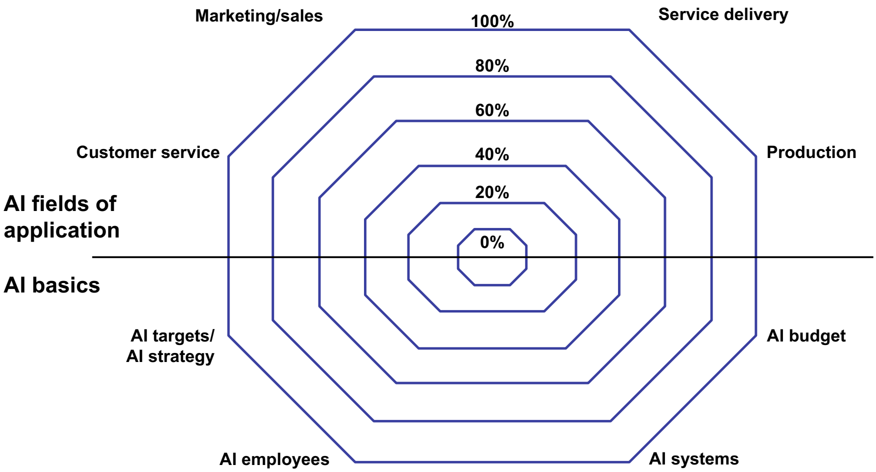

Fig. 10.3 AI maturity map—to be adapted to individual company requirements (Authors' own figure)

other fields. Before using the AI maturity map, you should therefore check whether it already depicts the areas of application that are important to you. If necessary, you can add further areas or remove existing ones.

Memory Box
It is important that you check every **link in your value chain** to see whether the use of Artificial Intelligence can **reduce costs** and/or generate **additional value contributions** for customers, suppliers and/or the company itself.

The contents of the individual **fields of the AI maturity map** are specified below. By using the AI maturity map, you will determine the extent to which the described content already exists in your company (**AI basics**) or is being used (**AI applications**). In the course of the analysis, you can assign between 0% (not available, not defined, not implemented) and 100% (completely available, fully implemented, used in day-to-day business).

Analysis of the existence of the AI basics

- **AI targets/AI strategy**
  At the beginning, you check whether there are viable goals formulated for the use of Artificial Intelligence in your company with regard to content, extent and temporal and spatial reference. Without an appropriate formulation of objectives, the activities cannot be successfully aligned. Therefore, check to what extent an AI strategy already exists. Here, it can be determined whether data and its use have already become success drivers in your industry—and if this has already been reflected in your goals and strategies.
- **AI budget**
  In the next step, you determine whether a budget has been set for the development and use of Artificial Intelligence. The amount of the budget—for example compared to the R&D budget or to turnover and profit—tells you something about whether it is a "mickey mouse event" in the sense of an alibi investment or a strategic investment in future projects.
- **AI employees**
  Here, you can find out whether you already have AI specialists (e.g. data scientists, ML specialists) on board in your company or whether you have to rely on external support alone. You evaluate how sustainable the own competencies already are. In addition you analyse at which hierarchical level and with which tasks, competencies and responsibilities people are entrusted with AI tasks.
- **AI systems**
  AI systems are machine learning platforms as a basis for own developments. Systems such as *Lucy* or *Albert*, which were described in Sect. 4.2.1, can also be used for this purpose. Applications such as *Amazon Rekognition* in Sect. 4.2.6, which can be integrated into your own applications using an API, are also part of the AI system landscape mentioned here. It should also be checked whether AI basic systems are used, as offered by the AI platforms Amazon SageMaker (2019) and Microsoft Azure (2019). In addition to accessing such systems, you

determine which data streams are available for processing in AI applications. Is it small data from your own company or is it big data that can include many other data sources?

In this analysis step of the AI maturity map, the question also arises whether and to what extent existing AI systems serve to support decision-making or whether they make independent decisions (without human control). In the worst-case scenario, your company is completely lacking such systems—and the company has a large number of data and process silos.

You can differentiate between the following **values for the AI basics** during valuation:

- 0–20%: Missing
- 20–40%: Point by point
- 40–60%: In individual areas given—but still not connected
- 60–80%: Available in many areas—partly connected
- 80–100%: Completely connected in terms of content and structurally anchored within the company.

Analysis of the existence of AI applications

- **Customer service**
  In this area, you determine—based on the defined AI targets—whether significant areas of customer service are already supported by AI applications. If all relevant fields of application are supported by AI solutions, you can assign 100% here.
- **Marketing/sales**
  In marketing/sales arises the question whether high potentials are identified by AI applications in order to reduce wastage during acquisition. In the course of customer care, AI solutions can support the development of the next communicative impulses and transfer them into marketing automation. For this purpose, customer-related data records can be checked to see whether certain patterns can be identified that point to sales potential (fields of application of predictive analytics).
- **Service delivery**
  In this field you determine the extent to which services are already supported by AI systems (e.g. facial recognition) or provided independently (e.g. by digital personal assistants or by humanoid robots).
- **Production**
  Here, you check the extent to which production is already supported by AI solutions. The tasks range from AI-supported procurement to production planning with AI-optimized resource control, predictive maintenance and AI-optimized transfer to the further logistics chain. If production is of great importance in your company, additional axes can be added to the AI maturity map for the analysis of further production steps.

You can assign the following **values to the AI application fields** during the analysis:

- 0–20%: No use or minimal beginnings
- 20–40%: Rudimentary deployment
- 40–60%: AI support available
- 60–80%: AI decisions are implemented according to human evaluation
- 80–100%: AI decisions are implemented automatically.

In a strategy meeting or based on a survey of the relevant company representatives, you can determine how the AI maturity is assessed from a self-perspective (**self-image**, **internal image**). For this, it is important that the respondents are aware that this is an honest stocktaking. To kid oneself is not the right way to handle this important subject. In addition, it can be very helpful—and possibly also very painful—to supplement one's own image with that of others (**external image**). For this purpose, external consultants can be used to support the (comparative) determination of the AI maturity. It is precisely an "external" view that broadens the horizon and helps you to look beyond your own company's and your industry's horizons to challenges that you are not aware of.

This also includes conducting an **analysis of the AI maturity of your most important competitors**. Again, it is important not to be closely oriented to the previously valid industry boundaries. Artificial Intelligence in particular will lead to industry boundaries becoming even less important and blur. New competitors often do not come from the own industry but are creative startups who simply try something new.

The result of the AI maturity analysis ideally shows that your company has already achieved an AI lead. Or it becomes clear that your company is already lagging behind today. In any case, the responsible managers will now have to start an AI journey in order to vigorously promote the AI commitment.

Summary

- Using the AI maturity map to analyse your AI maturity is an indispensable first **step in AI design**.
- Here, you can systematically determine whether you have already created the **basics** for the successful use of Artificial Intelligence in your company.
- In addition, you can recognize in which **fields of application** Artificial Intelligence has already been incorporated.
- Based on the results of the **AI maturity map**, start your AI journey.

10.3 Development of an AI Journey in the Own Company

Artificial Intelligence has the potential to fundamentally change society and the economy. Nevertheless, there is still a great deal of uncertainty about how and, above all, how fast this technology will develop. You should not take a **wait-and-see approach** to your business. This could—not in the next two to three years but later—lead to serious competitive disadvantages. You better **start the AI journey** today in order to gradually increase the AI potential for your company. The aim is to analyse the opportunities and risks of this technology for your own company and industry in greater depth.

With this goal in mind, you should speed up your AI journey—backed up by the results of the AI maturity map—if you have not already launched it comprehensively. The following **prerequisites for a successful AI integration** must be created in your company:

- **Creation of own AI competencies** through the acquisition of new as well as through the training of existing employees and/or the access to external AI resources.
- **Definition of the target corridor for the use of AI**, e.g. process optimization, the development of product and service innovations or the opening up of new business fields, in order to contribute to the sustainable development of the company.
- **Establishment of an own data ecosystem** by the creation of a balanced and large database for the training of algorithms or **access to or participation in an external data ecosystem**.
- **Development of powerful algorithms** for specific use cases
- **Preparation of a change management** in order to take the entire organization and each individual employee on the AI journey.

In order to design this process successfully, you can orient yourself on the subsequent **phase concept of the AI journey**.

10.3.1 Phase 1: Comprehensive Information Gathering

Before you develop an AI strategy, it is essential that you and your employees are fully informed about the entire field of Artificial Intelligence. Go beyond the buzzwords as well as the media euphoria or media pessimism. Develop a meta-view through a carefully selected **AI competence team** that helps you to grasp the different AI approaches from computer science, business, politics, psychology or philosophy. Each perspective represents a gear to light the AI journey!

Create opportunities for the entire company to come into contact with AI systems and AI applications—as through an **AI hub**. They should also support a playful exploration of Artificial Intelligence in order to reduce fears and recognize

the benefits of these technologies. The experience you gain here will enable you to identify the first AI application areas for your company. Compare the advantages and disadvantages of using AI technologies in your company. In many cases the advantages will outweigh (in the long run)!

In this phase of information gathering, answering the following questions is helpful. Here, you can see how Artificial Intelligence will change the **competitive basis between sectors and companies** (cf. McKinsey, 2018, p. 47f.):

- Which industries and which companies will have particularly easy **access to IT computing power, data, algorithms and a skilled workforce**?
- How will this **competitive situation** develop over the years—which industries and which companies will win, which lose?
- How will **industry structures** develop—which will lose importance, which (possibly new) industries will gain?
- What role will **technology platforms** play in the transformation process?
- How can the **transformation in your own company** be designed in order to integrate employees into AI-supported processes?
- Which **process optimization** and which **redesign of processes** can be achieved through the use of AI technologies?
- Which **product and service innovations** can be developed using AI technologies?
- How can the necessary **collaborative, agile and non-hierarchical organizations and cultures** be built?

This information phase also includes the question of which **use cases are particularly important for your company** in order to provide the relevant resources. It is crucial that you combine the use cases with the corporate and/or business strategy at an early stage in order to obtain the top management support and budgets necessary for successful AI deployment. It is crucial not to follow the AI hype uncritically, but to define AI fields of application that are relevant for your company and promise a positive ROI. The various fields of application discussed in before can support your creative processes.

To determine the relevant use cases, use the **3-horizon model** presented (cf. Figs. 10.1 and 10.2).

- On the **horizon-1 level**, you can first check which of the processes used today can be made more efficient and/or value-adding by using AI. The following risk is associated with uncritical use of technology:
  If you digitalize a shitty process, you will get a digitalized shitty process.
  Therefore, AI integration into existing processes only makes sense if these processes are already running optimally. But even in this case, the question arises whether you could not achieve more convincing results with an AI-based re-design of processes.
  In addition, it must be determined whether you can achieve immediate performance improvements through Artificial Intelligence in your existing

product/service portfolio. Here, you can concentrate on those use cases in which proven AI technologies are already available. This includes the automation of production processes, the use of predictive maintenance or the refinement of analysis options in the CRM area (such as customer value analyses or credit ratings). You can use a one- to two-year horizon as a basis to achieve measurable success.
- With the **horizon-2 level**, you broaden your view and check which new **AI-driven processes** can significantly develop existing activities. In addition, you should promote an **analysis of the entire range of products and services**. In this way, you can determine which thorough improvements or additions to your offered portfolio can be achieved by Artificial Intelligence. This level includes the integration of chatbots into the customer dialog or the use of AI applications in the diagnosis and therapy area in healthcare. Another example of this level is the development of digital twins of plants and aggregates in order to open up new business fields for already established activities. Here, you can concentrate on a two- to four-year horizon.
- Finally, the **horizon-3 level** directs the perspective significantly beyond the existing business model and challenges you to search for exciting AI cases in related and/or **new task areas** and **innovative business models**. This is certainly the most demanding area of analysis. In order to achieve success here, you must overcome familiar patterns of thought and action. For this, it can be helpful to work together with strong external partners from science who work at the forefront of development. The intensive cooperation with startups also helps to focus attention on radical AI-driven innovations. You can base this horizon on a three- to five-year period.

A **test-and-learn approach** is practiced on all three horizon levels. For this purpose, the respective business cases must be validated on an ongoing basis. Temporary experiments must be carried out for this purpose. In this way, you can quickly determine which approaches can prove themselves and thus secure future potential for success. When evaluating AI initiatives, commercial and technical managers should be equally involved in order to bring both perspectives together in a **holistic evaluation approach**. In that way, you can prevent a silo formation: technology here, business case there.

Such silos meant that the managers responsible for IT, digital or innovation were alone in the lead, sometimes without a target-oriented focus on business cases. This partly led to the "**hammer searches nail**" **phenomenon**. You can counteract such a development with the holistic valuation approach described above. It is important to ensure a consistent value orientation of AI commitment—instead of a youth research approach (cf. McKinsey, 2017a, p. 33). During implementation, you should use the **methods of agile product management** (cf. Kreutzer, 2019).

You can determine the **necessity and urgency of an AI deployment for your company** using an AI-specific adaptation of the **business model canvas**. On a canvas such a concept—clearly visible—can be developed (cf. in-depth Kreutzer, 2019, pp. 70–74). Figure. 10.4 shows a **canvas concept for the use of Artificial**

AI opportunities	AI risks	AI targets	AI data base	AI resources
▪ Which potentials can be raised by AI in our industry? ▪ What can we gain as a company through the use of AI? ▪ Which AI use cases are particularly exciting? ▪ ...	▪ What risks are associated with the use of AI for our industry? ▪ Which risks are associated with the use of AI for our company? ▪ How are the legal risks to be assessed (data protection)? ▪ How will customers evaluate an AI commitment? ▪ ...	▪ Which process improvements for customers can be achieved? ▪ Which new products/ services for customers can be developed? ▪ Which optimizations in the supply chain can be achieved? ▪ Which potentials in the production area can be leveraged? ▪ ...	▪ Which relevant data is already available internally? ▪ Which data can be procured externally? ▪ Which data gaps can be identified - and how can these be closed? ▪ How can continuous data collection be ensured? ▪ ...	▪ Which AI employees are required? ▪ Which external resources are required? ▪ Which IT infrastructure is necessary? ▪ Which networks along the value chain are necessary? ▪ Which additional investments are necessary? ▪ ...

Cost structures	Revenue structures
▪ What are the initial costs associated with using AI (systems, licenses, programming, data, employees, training)? ▪ What are the running costs of using AI? ▪ What are the costs associated with change management in the direction of artificial intelligence? ▪ ...	▪ Which revenue potentials can be identified in which areas (direct/indirect customers, new/advanced processes, new products/services)? ▪ In which periods can their entry be expected? ▪ What uncertainties are associated with the expected revenue? ▪ ...

Fig. 10.4 Canvas for the use of Artificial Intelligence (Authors' own figure)

Intelligence. With this concept you can determine the relevance of Artificial Intelligence for your company. The advantage of this canvas approach is that you can use it well in in-house workshops to work together on AI topics. If you use this **canvas for visualization in large format**, ideas and suggestions can be inserted directly into it by post-its.

Figure 10.4 also shows the question of when an **ROI can be expected for AI investments**. A study by McKinsey (2017a, p. 35) of more than 3,000 internationally active companies provides exciting results in this regard:

- 41% of companies say that **uncertainty about ROI** is one of the biggest obstacles to further AI deployment.
- 26% report that **convincing AI application cases** are still missing.

It is your urgent task to also answer these questions when using this canvas variant. Then you can enter phase 2.

10.3.2 Phase 2: Systematic Preparation of AI Deployment

An important basis for the successful use of AI is the **establishment of a data ecosystem** of its own (cf. McKinsey, 2017b, p. 33). Based on the business cases defined in phase 1, you start with the description of the data that is relevant for the selected use cases. Then, you check which of these data already exist in the company and which of them your company may even have exclusive access to. By comparing data target and data availability, you will identify more or less large **data gaps**. Now the exciting task of opening up further important data sources begins. Here, you should consider the criteria to be taken into account when selecting data (cf. Sect. 2.4).

At this point, you will often painfully find out which liabilities the GDPR has in store for you when working in the European Union—and to what extent companies such as *Amazon, Facebook* and *Google* can draw on the full potential in comparison. In order to compensate for this competitive disadvantage, cooperation with other data partners can become meaningful and necessary in order to overcome the limits of one's own data access. To this end, it may become necessary to set up a **data ecosystem** with third parties in order to close important data gaps. In addition to **"tapping" relevant data sources**, the **utilization of a wide variety of data formats** poses another major challenge. If different data streams can be brought together in a larger ecosystem, this can lead to lasting competitive advantages. The continuous flow of data from sensors and machines, and especially from social networks, must be managed—often in real-time.

The **development and recruitment of our own AI talents** is another major task. If you do not yet have your own AI expertise, it is worth using **external service providers** at the outset to accelerate internal AI processes. This also includes **projects with research centers** in order to gain access to qualified employees. **Cooperation with companies** in your own sector can also contribute to this, even if you are in competition with them. For innovations on the horizon-3 level, it is often even necessary to overcome one's own industry boundaries. Cooperation with AI startups or other leading AI companies can be very helpful here.

One possibility is the ***Partnership on Artificial Intelligence***. This was initiated in 2016 by AI researchers from *Amazon, Apple, DeepMind, Facebook, Google, IBM* and *Microsoft*. In 2017, the partnership was expanded into a **multi-stakeholder organization** with the addition of six nonprofit board members. Today, it represents more than 50 member organizations. This alliance follows the motto (Partnership-on-AI, 2019):

> **Bringing together diverse, global voices to realize the promise of Artificial Intelligence.**
>
> In support of our mission to benefit people and society, the Partnership on AI intends to conduct research, organize discussions, share insights, provide thought leadership, consult with relevant third parties, respond to questions from the public and media, and create educational material that advances the understanding of AI technologies including machine perception, learning, and automated reasoning.

Depending on the strategic AI relevance for your company, it may be expedient to join this alliance or to intensively follow the discussions held there. In addition, it is worthwhile to look into the idea of the ***Fraunhofer Big Data Alliance***. In order to satisfy the "data hunger" of companies, this alliance offers direct access to the competence spectrum of *Fraunhofer* experts. For this purpose, industry know-how is combined with current research methods of intelligent data analysis. The core areas of the *Fraunhofer Big Data Alliance* cover the following areas (cf. Wrobel & Hecker, 2018, p. 263f.):

- Production and industry
- Logistics and mobility

- Life science and healthcare
- Energy and environment
- Safety and security
- Business and finance.

This phase is also about testing the suitability of the already mentioned AI platforms ***Amazon SageMaker*** and ***Microsoft Azure*** for your own developments. For this purpose, the employees must be qualified accordingly. In addition, you should check whether your projects can be supported by **state financing possibilities**. The following **checklist** will help you to prepare the use of Artificial Intelligence in your company:

- The **conversion of possible use cases into profitable business cases** is essential for a successful AI journey. It makes no sense to place a humanoid robot in the reception area of a hotel if it neither benefits the guests nor generates a positive ROI in the long term by making service processes by robots more cost-effective.
- Make sure you have an appropriate **context**! Think about whether you are, for example, a traditional Alps hotel or an urban art hotel before using AI applications in the service area. If you are looking after a predominantly older clientele, you should also not overburden them with excessive AI-based modernity. Here, it is more crucial to simplify and streamline processes without stirring up AI-related fears.
- The use of Artificial Intelligence requires a real sense of **timing**. This has to fit first for your employees and only in second place for the customers. If your employees do not support the AI applications, they will not be convincing in the eyes of the customers. Therefore, it is important that especially the employees in direct customer contact have intensively dealt with your AI solutions visible on the customer front and can represent them positively towards the customers.
- An important field of application for AI solutions is the **individualization** of information and offers. In connection with a marketing automation you can create important customer advantages here. Whether the advantages you have in mind are also seen in this way by the customers should be checked promptly in each case. Company ideas and customer expectations are often not at the same level (cf. Fig. 4.1).
- Don't wait until your competitors are already entering the market with new solutions before you start exploring the possibilities of Artificial Intelligence for your company. Take on an **active innovation role**—supported by budget and expertise!
- Keep an eye out for your **customers' solution needs** and build a **network** in which you can exchange ideas with other exciting partners and develop joint solutions. Agile project methods such as Design Thinking can help you identify new business models for AI use.

- Develop your own **ethical guidelines** and apply them to your AI applications. The development of laws is much slower than the development of new technologies. This also increases your personal responsibility to create products, services and processes that aim to benefit people. So that technology helps people —and not the other way around.

10.3.3 Phase 3: Development of AI Applications

You should be aware that the use of Artificial Intelligence usually does **not promise short-term success**. The benefits for the customers as well as the ROI for AI applications will only be realized later. That is why you have to create a constant **test and prototype mentality** in your company that leaves enough room for failure. To do this, your managers need "skill-to-kill" to end projects—without damaging their own reputation—if the expectations placed are not fulfilled. This sounds frustrating at first, but in the long run it is crucial for success. At the same time, you must not be too impatient with the ROI expectations of AI projects; otherwise you will end some projects before they have proven their worth.

Memory Box
How long did it take *Amazon* to go from being a laughed at cash burner to an admired and feared global profit machine? How long have profits been reinvested in the company to open up new growth areas? Many, many years! And now *Amazon* is one of the most valuable companies in the world and is dominating more and more service fields! In many areas, it no longer seems catchable—at least not by Western companies!

In order to develop relevant use cases, you can apply the proven method of Design Thinking (cf. Kreutzer, 2019, pp. 180–186). **Design Thinking** is based on the approach of designers who follow the phases of observation, understanding, brainstorming, prototype development, refinement and execution in their work in order to find convincing solutions. The phases are repeatedly jumped forwards and backwards in order to achieve the greatest possible learning effects. The creative process of Design Thinking makes use of these considerations through a special methodology and various tools. The focus is on **consistent customer orientation**, which is also of great importance for AI developments. These "customers" can be located within the company (in the sense of their own employees, e.g. in marketing, sales, product development, production, procurement) or outside the company.

The following **characteristics and principles of Design Thinking** should be taken into account when developing AI-based products, services and processes:

- **Designing the team for Design Thinking**
  In Design Thinking, multidisciplinary teams are formed that bring in different horizons of experience. Diversity here means both male and female, young and

older as well as “starter” and “old hands”. In addition, various corporate divisions will also be represented in these teams in order to support a holistic perspective on AI deployment.

Here, we search for so-called **T-Shape personalities**. These are people with a wide range of interests and a high level of professional expertise. The vertical part of the letter “T” stands for a deep knowledge in a certain discipline. The horizontal part of the letter “T” expresses the broad and transversal knowledge necessary for the persons concerned to contribute.

- **Course of the Design Thinking process**

  The course of a Design Thinking process often includes the following steps, the contents will be deepened later:

  - **Emphazise**: building up empathy for the target persons; here it is necessary to recognize their starting position in order to achieve a job-to-be-done image.
  - **Define**: Definition of the task to be processed; this must be described from the user’s point of view.
  - **Ideate**: Obtaining solution ideas.
  - **Prototype**: Rapid development of prototypes with the simplest of means.
  - **Test**: Verification of the found solutions with the target persons.
  - **Decide** (if necessary after several iterations in the sense of runs): Decision for a solution idea that is implemented promptly.

A special feature of Design Thinking is the consistent target group orientation, which is reflected in all process steps. The process also alternates phases of divergence and convergence. In the **phases of divergence**, the focus is on the quantity of solution ideas that are collected via various brainstorming methods on post-its. Here, the aim is to develop the greatest possible variety of ideas. In the **phases of convergence** it is primarily a matter of condensing and bringing together the knowledge gained, and the ideas developed.

Feedback is an essential part of a Design Thinking process. Various **feedback methods** are used for this purpose. One example is to evaluate a process step in four rounds. Everyone who gives feedback slips into a special role:

- Round 1: The **critic** sees only the negative in the result.
- Round 2: The **visionary** sees the possibilities for the future.
- Round 3: The **pragmatist** limits himself to pure functionality.
- Round 4: The **advocate** sees the benefit that the result brings to the customer.

Approaches such as these “force” a certain perspective for the feedback on a process step or prototype. This allows personal assessments to take a back seat. The knowledge gained (divergence) is evaluated and processed into new solutions (convergence).

The **visualization** of the developed ideas is of great importance throughout all phases. This already begins with the presentation of the **persona** for whom a new

service concept, an app or a new product is to be developed (cf. Kreutzer, 2019, pp. 60–65). This promotes the desired empathy. The knowledge gained and the solution ideas developed can be visualized in the form of sketches and storyboards. **Storytelling** is used to further promote understanding and empathy. To this end, concrete application situations, pain points and expectations of the personas can be packed into little stories in order to further promote the understanding of the perspective of the personas.

Another important part of Design Thinking is **rapid prototyping**. This process deliberately avoids the expensive development of prototypes that are as realistic as possible. Rather, it is a matter of developing several (simple) prototypes quickly and with little effort already in the early phases in order to test their functionality by the final users.

This results in **iterative loops** (iteration) in the sense of several runs of the same process steps: New findings lead to new ideas, new prototypes, new test results and new decision options. These results drive the creative and evaluation process. Thus, the process of learning and a step-by-step approach to an ideal solution continues over several rounds.

- **Design of space and time of the Design Thinking process**
  The space and time concept must promote the flexibility and dynamics of the Design Thinking process. Therefore, the room should have a high degree of flexibility with regard to the media to be used. Meta-plan walls, flipcharts, bar tables and play corners—if possible everything on wheels or easy to move—are part of the basic equipment. In addition, creative processes can be supported by meta-plan cards and post-it notes of different colors and sizes. Different materials are provided for the development of prototypes. The spectrum ranges from clay and *Lego* bricks to other building materials.
  In order that the participants in a Design Thinking process are not permanently caught up in day-to-day business, it is advisable to use premises that are detached from the traditional workstation. This can still be in the same building—but optically separated and if necessary provided with big hints like "Please do not disturb creative processes". It is not without reason that many agencies offer their clients appropriate premises so that they can work undisturbed.
  Creativity takes time. That's why a Design Thinking process cannot be quickly scheduled between "soup and lunch". All those involved should have possibilities to fully concentrate on the defined task. That's why the following applies here: Mobile phones, tablets, laptops can simply be turned off once (there are buttons on the devices for this often rarely used functionality!).
  The **process steps of Design Thinking** described above are explained in detail below so that you know exactly what should happen in which phase (see Fig. 10.5).
- **Empathize: building empathy for the target persons**
  The Design Thinking process starts with an empathize phase (gaining empathy). The various information and studies that create a good understanding of the initial situation of the target persons are compiled for this purpose. Particularly helpful

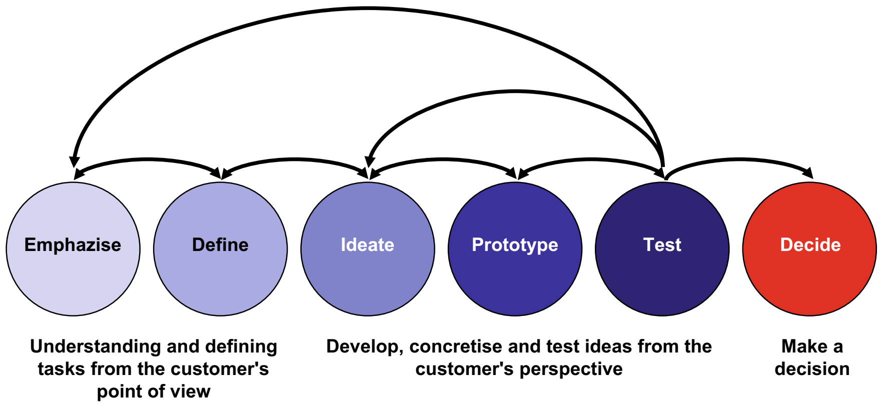

Fig. 10.5 Phases of the Design Thinking process (Authors' own figure)

are insights gained through focus groups and/or in-depth interviews. These often allow a particularly comprehensive insight into the mood of the target persons. In order to sharpen this perspective, the already mentioned personas are used. These are to be understood as fictitious people who represent specific target groups. They support the assurance of a user-centered focus. For these personas, so-called **empathy maps** can be developed, which visualize central aspects of the previously researched mood and express further relevant aspects, such as how these personas are adjusted to possible AI applications (cf. Fig. 10.6).

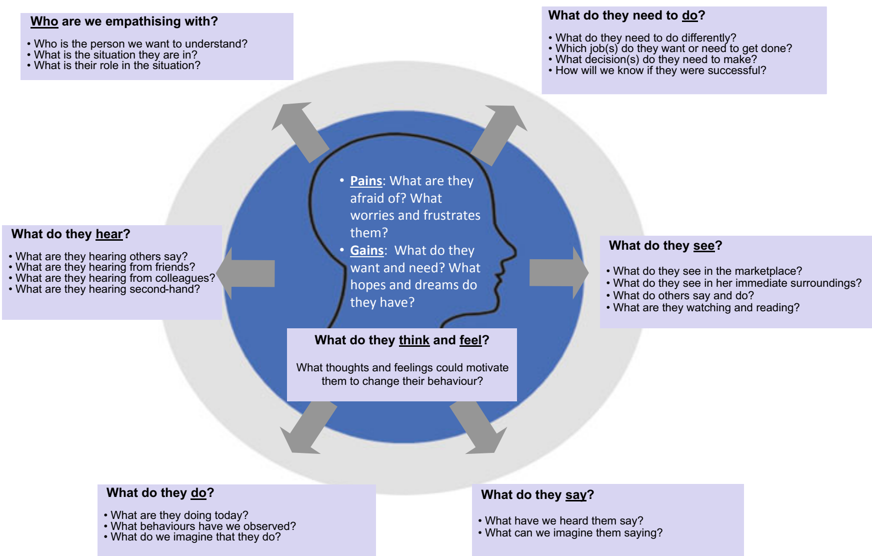

Fig. 10.6 Empathy map for a persona (Authors' own figure)

An empathy map supports you in determining the relevant customer wishes, pain and gain points as well as the individual needs of a persona. With an empathy map you focus especially on the emotional state of a persona by understanding the individual sense organs and their perceptions or emotions. For this purpose, the persona is positioned in the center of the empathy map with the fields "pain" (for "pain points") and "gain" (for "achieved/won"), which can accompany the AI use. Around them other sectors are defined and illuminated with certain questions. These six defined areas must now be filled with content—always consistently from the perspective of a concrete persona!

Memory Box

At the center of Design Thinking is a persona, to whom the entire development is directed. This persona must be understood in depth. This is an indispensable prerequisite for developing really relevant use cases.

- **Define: definition of the task to be processed**
  Based on the information above, the define phase is about formulating a question that is as precise as possible. This is referred to as a **design challenge**. Now it is important—with the persona in mind—to find a formulation of the initial question. This is referred to as **point of view** as the basis for brainstorming:

  - What specifically does this persona need that can be promoted by an AI application?
  - Why does she need it?
  - What does he want to achieve?
  - Which resistances might stand in the way of an AI-based use?
  - What support does the persona expect from us in order to act beneficially with the AI application?
  - Which side could provide additional assistance?
  - How would a solution, a service offering, a product have to look like that can meet these expectations?

- **Ideates: obtaining solution ideas**
  In the phase called ideate, ideas and first problem solutions are developed. First of all, there is a multitude of solution ideas (keyword divergence). Different creative methods can be used (e.g. mind maps, brainstorming, attribute listing). This is followed by a phase of convergence, in which a selection of possible solution ideas is made, which are further processed in the next phase. After the creative life a higher rationality returns here again!
- **Prototype: development of prototypes**
  Rapid prototyping is used in the prototype phase (cf. Fig. 10.7). Using the simplest means, attempts are made to create initial prototypes for learning and testing purposes. Depending on the respective solution idea, sketches, wireframes, storyboards or 3D models can be used. Creativity is only limited by time

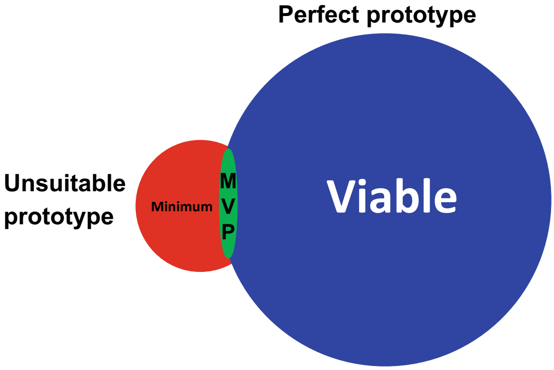

Fig. 10.7 Concept of the minimum viable product (MVP) (Authors' own figure)

and budget. When processes and service concepts are designed, role plays can also be used to test the functionality of specific processes.

- **Test: Verification of the solutions found**
  The prototypes are shown to users in the test phase. Depending on the knowledge gained, there are various alternatives. If the prototype fails, the ideate process can be restarted based on new findings. If the prototype found favor these can be processed in a new ideate process. If the prototype has been accepted by the target persons (possibly after several iterations), the transition to the last stage takes place. This demonstrates the great flexibility of Design Thinking. Individual phases are simply run through so often until a convincing solution is found.

- **Decide: decision for a solution idea**
  After "acceptance" of the prototype by target persons, the Design Thinking process is completed. Now the solution concepts gained can be transferred to the "classic" organization in order to be developed and introduced to the market there.

The following **guiding ideas of Design Thinking** should be followed at all stages of the process:

- Fail often and as early as possible (and inexpensively)!
- Failure is an inexhaustible source of learning!
- A large autonomy of the team is important!
- Constructive feedback is a must!
- Learn continuously!
- Make solutions tangible!
- Let the customers decide what is really successful!

However, resist the temptation to carry out a Design Thinking project in a timely and cost-effective manner in the sense of a one- or two-day workshop! The individual phases have made it clear that it is precisely the extra time that is created to allow failure to happen that provides the impetus for the best creative ideas. Look for reliable partners who can accompany these projects as external partners.

The **lean startup** development concept can be used additionally or alternatively for the development of concrete AI fields of application. The aim is to bring solutions to the market more quickly that are highly relevant because there is a convincing supply/demand fit. By using lean startup, you can make an important contribution to ensuring the **supply-demand fit** that is decisive for success through a specific procedure to a greater extent (cf. also Lennarz, 2017, pp. 63–72).

Memory Box

The core idea of lean startup is as simple as it is obvious—and yet often not consistently implemented. The point is that you develop a product or service very close to the market and include continuous feedback from potential customers during the development process.

You leave the ivory tower of product and service development and face the criticism of your target persons early and relatively unprotected. But better early and unfiltered than after completion of the development work, if all budgets for development and market launch have already been used—and if necessary no one dares to stop the less promising project any longer!

Lean startup is designed to help you develop market-relevant AI-based innovations. The **time span between product development and market launch** must be significantly shortened. Many companies still align their behavior with the **time-to-market** approach today. The time-to-market is measured in days, weeks, months and/or years and indicates the lead time between a product/service idea and its launch on the market. During this time, the product/service development phases as well as any market tests that may have been carried out are covered. Since there is no productive deployment during this period and thus no "test" in actual deployment, this is associated with major risks of an erroneous development. At the same time, costs for market research, prototype construction, communication etc. are incurred. Turnover is generally not yet generated. A value for the customer is achieved through product/service innovation only after completion of the development and test phase and consequently after the launch of the product or service innovation (cf. Fig. 10.8).

You should try to bring AI-based innovations to market as quickly as possible in order to pre-empt competitive offers. In many European companies, a too long time-to-market is still frequently observed. This means that a lot of time passes before a marketable product or service innovation is available. Late market launches are particularly detrimental to products and services with a very short life cycle—especially if a lot of time still needs to be invested in development. The faster an offer is replaced by a revised one, the more unsuccessful the companies will be that have not geared their development processes to speed.

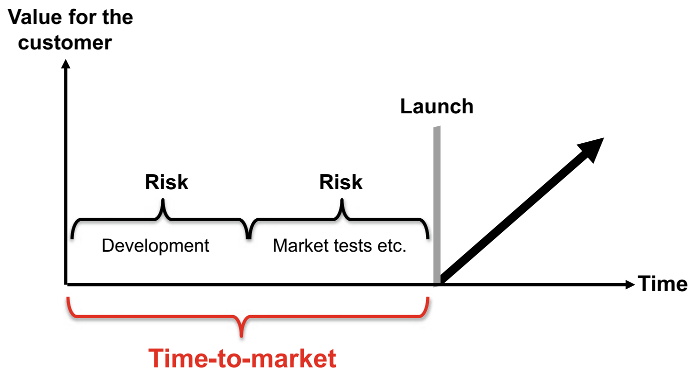

Fig. 10.8 Time-to-market (Authors' own figure)

Memory Box
An orientation towards the time-to-market is becoming less and less appropriate to today's demands for the speed of innovation processes.

In order to achieve speed, you should therefore concentrate more on time-to-value. The **time-to-value** is also measured in days, weeks, months and/or years and indicates the **lead time between a product/service idea and its first customer benefit**. Consequently, you do not wait until a perfect product or a perfect service innovation is available in order to launch it on the market. However, all offers should be error-free when they are introduced.

Memory Box
Today, the challenge is: **focus on time-to-value!**

Rapid prototyping, which has already been mentioned, can contribute to shortening time. Here, the aim is to generate "tangible" products and services from the product/service idea as quickly as possible in order to test their suitability. In addition, the market launch can begin at a certain point in time, when a stable product or a functioning service innovation is available that can generate value for the customer. This is a kind of **pre-launch**. It marks a very early introduction into the market with a first functional product or service. This is described with the term **minimum viable product** (MVP). It refers to a product or service that meets the minimum requirements to be used by customers (cf. Fig. 10.7).

Compared to the time-to-market approach, the pre-launch mentioned above enables you to achieve a **customer benefit** much earlier. At the same time, you will learn in cooperation with real customers, where optimization needs do exist, and which further features need to be developed with particular urgency. This continuous development goes hand in hand with an early creation of value for the customer. You can launch the "final" product or the "finalized" service at a later date. A smooth transition from the pre-launch to the launch phase is often an obvious option—with continuous value creation for the user (cf. Fig. 10.9).

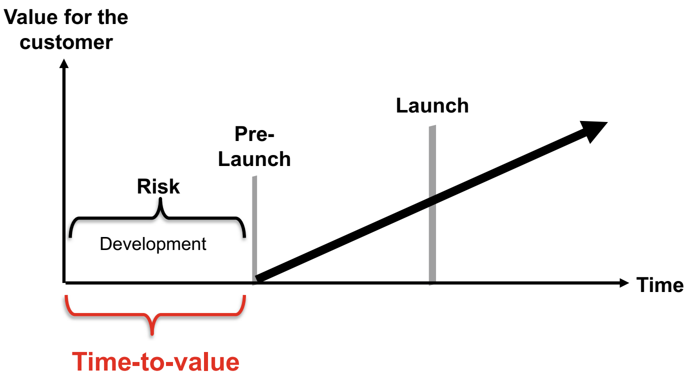

Fig. 10.9 Time-to-value (Authors' own figure)

As soon as an operational product or a functioning service innovation is available, you can offer it to a (limited) circle of users ("**pre-launch phase**"). In cooperation with "real" users, you can gain ideas for the further development and optimization of the offer and take them into account in the not yet completed innovation process. The actual **launch** follows with a time lag (cf. Fig. 10.9).

Memory Box
By **focusing on the time-to-value**, you can achieve several goals:

- Firstly, your company can penetrate the market earlier with its own AI offerings.
- Secondly, you can fine-tune a product or service in a real market environment—and identify and stop undesirable developments at an early stage.
- Thirdly, you may already be able to achieve your first (reduced) returns by offering a 70/80% solution. This enables you to at least partially cover the costs incurred in the innovation process for market research, prototype construction, communication, etc.

The **lean startup method** is based on the following considerations and offers a market-oriented procedure model in three stages, which is also relevant for the development of AI solutions (cf. Ries, 2017):

- Build
- Measure
- Learn.

The goal of this approach—based on the idea of time-to-value—is to bring a product, a service or a complete business idea to market as quickly as possible. In order to achieve high relevance for the target group, comprehensive feedback should be obtained as early as possible. This is intended to provide impetus and

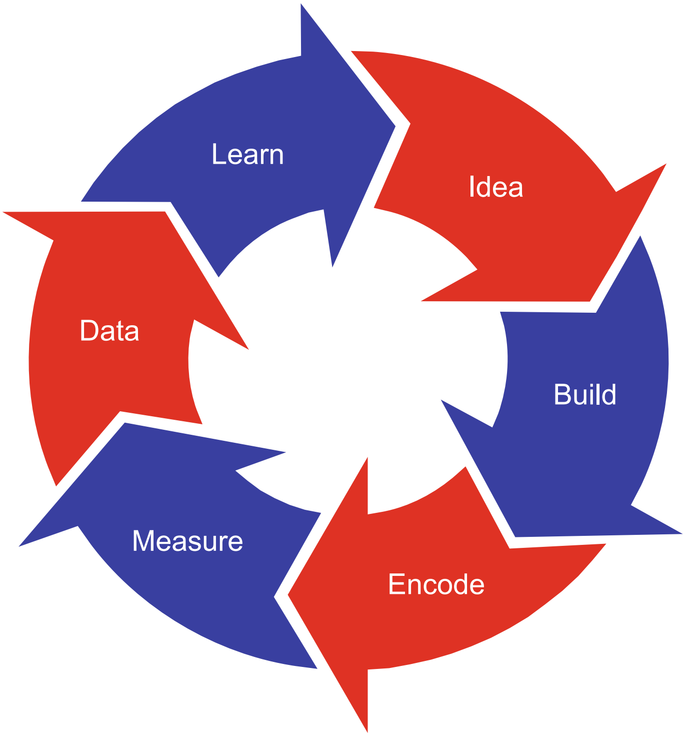

Fig. 10.10 Lean startup model (Authors' own figure)

ideas for further development and, if necessary, for a reorientation of the innovation. Through this consistent market orientation, you can save both time and money.

For this purpose, iterative tests of important performance features of the product or the service itself are carried out. You can also "test" pricing, distribution concepts, positioning ideas and elements of brand management on the market during the ongoing development process. Since this process is constantly repeated, the **build-measure-learn cycle** shown in Fig. 10.10 results. This enables you to consistently align your services to the requirements of the market. You repeat this cycle with a lean startup until the solution is accepted by the market.

Which concrete contents characterize the individual phases of the **build-measure-learn cycle**, is described below.

- **Phase 1: Building—lean product/service development based on an initial hypothesis**
  The starting point of the build-measure-learn cycle is an **idea** in the form of a market problem which is to be solved. The start of product, service and/or business model development is based on various hypotheses that have to be tested on the market during the course of the process and, if necessary, adapted or rejected.

The concept of the canvas business model can be used for **building** and thus for the process of developing a new solution (cf. Osterwalder & Pigneur, 2010). A comprehensive business plan is not yet necessary in this early phase, since the solution idea can change several times—possibly dramatically—in the course of the iterative approach.

Based on the results of the canvas approach, a first prototype of the solution can be created—possibly using the Design Thinking already presented. This should initially only contain the central functions and/or properties of the proposed solution in order to reduce complexity. Products can be reproduced with their core services in the prototype—without the need for beauty and design. With services, the process steps in the prototype can be limited to the central features. This "miniature output" of the final performance is called—as already mentioned—the minimum viable product (MVP, cf. Fig. 10.7).

- **Phase 2: Measure—comprehensive feedback acquisition from potential customers**

  If the activity referred to as **encoding** in Fig. 10.10 has resulted in a minimum viable product, the **measurement** phase occurs. The aim is to check the relevance and functionality of the solution found in the market. For this purpose, the prototype or minimum viable product is presented to the target customers and feedback is obtained. In addition to focus groups and surveys, workshops can also be held with the target persons. A lean procedure also saves time and money in the measurement phase.

- **Phase 3: Learning—analysis of feedback and development of new hypotheses**

  Based on the data obtained during the measurement phase, the necessary learning takes place. For this purpose, the knowledge gained shall be comprehensively evaluated in order to test the validity of the original hypotheses of the just completed build-measure-learn cycle. After the initial run of this cycle, the following questions can be answered:

  – Does the problem on which the first cycle was based exist at all, or do (alternative) solutions already exist?
  – Are people interested in solving a problem at all?
  – Is there a willingness to pay an "appropriate" (from your point of view "profitable") price for the intended problem solution?
  – Was the development based on the right persona?
  – Is the intended distribution channel suitable for the target group?
  – Is the desired positioning understood?
  – Does the brand concept transport the core idea of the service?

You may find that some of the initial hypotheses were certainly incorrect. You can be pleased that this became clear so early in the course of this process and that you can now continue working with new findings!

Memory Box
If you fail, fail fast, fail cheap and fail early!

Based on the knowledge gained, you can formulate new hypotheses for the next build-measure-learn cycle and starting the next cycle. It is important in all measuring and learning phases that you base your findings on sufficiently large amounts of data. Otherwise, you may be led in the wrong direction by a small amount of data.

After the learning comes the next idea, the next building, the next encoding, measuring, learning! On the basis of the knowledge gained in this way, you cannot only orient your hypotheses, but also your solutions more and more comprehensively to the market. The build-measure-learn cycle comes to an end when you have the impression that the market is quite “hot” on your offer.

Building on the findings of these so-called pre-launch phases, the launch phase follows, i.e. the comprehensive market launch (cf. Fig. 10.9). By running the cycle several times, your risk of failure has been significantly reduced—with little use of time and resources.

In order to support companies in the (initial) use of AI, the company *33A* has developed the ***AI Design Sprint Method*** (cf. 33A, 2019). The objective is to develop AI applications for your own company in a team. The concept is derived from the *Google Design Sprint*. The AI Design Sprint is used in different variants, which depend on the task of each company. Starting point can be the end customer (AI Design Sprint “New Services”), a single product (AI Design Sprint “Product Amplification”) or certain business processes (AI Design Sprint “Process Automation”). The AI Design Sprints start with the **Design Phase** of AI applications and consist of the Pre-Session, AI Design Sprint Session and Post-Session phases. The **Implementation Phase** itself with the steps Proof of Concept, development of the business case as well as the check of scalability are not covered by the AI Design Sprint.

The individual steps of the design phase are examined in more detail below using the **AI Design Sprint** “New Services”. The Pre-Session defines the persona for whom you want to develop an AI solution. This definition also sets the course for the necessary procurement of information—internally as well as externally. The Pre-Session starts with Fig. 10.11.

This step is supported by Fig. 10.12. The aim is to specify the wishes and expectations. In order to determine these, the empathy map shown in Fig. 10.6 can mediate important impulses.

In the **AI Design Sprint Session**, participants develop a new AI-based service that can be visualized in the form of a user journey. Among other things, you select which AI technologies can be used to meet the wishes and expectations of your customers. The selection process is supported by the **AI Card Deck** shown in Fig. 10.13. This is where it is decided which AI technology or technologies are to be used.

Fig. 10.14 uses an AI Card to show which functionalities can be covered, for example, with the card “Understands what it hears”.

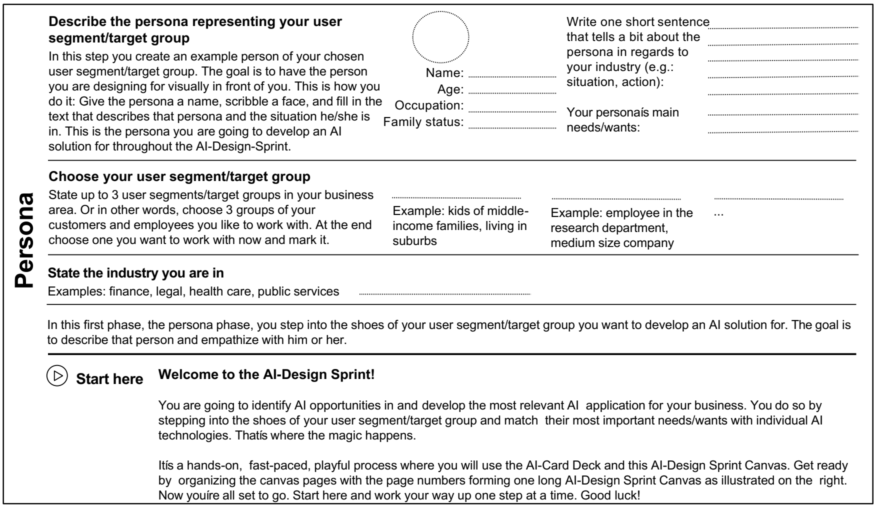

Fig. 10.11 AI Design Sprint—Persona. *Source* 33A (2019)

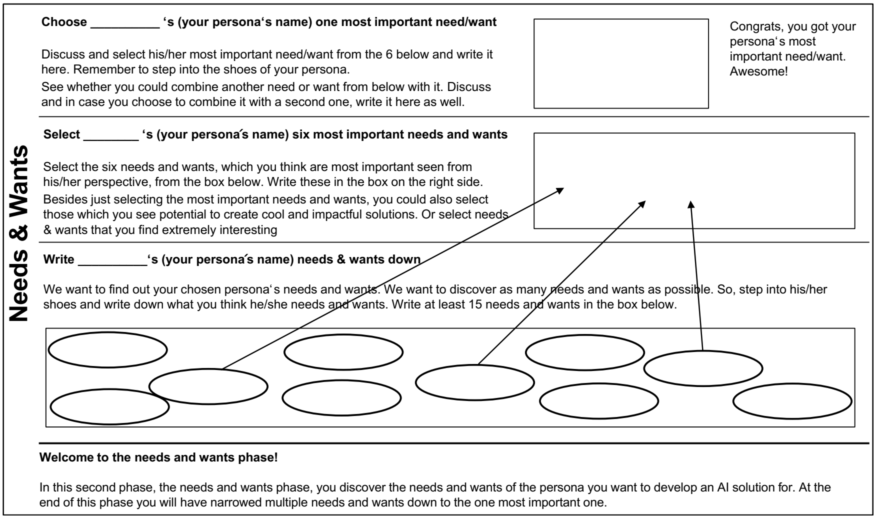

Fig. 10.12 AI Design Sprint—Needs and Wants. *Source* 33A (2019)

These cards are used as shown in Fig. 10.15 to further advance the process. Now the User Test is closing (Fig. 10.16).

For this **User Test**, the **solutions are to be developed in drawings or simple models** (keyword rapid prototyping). These are presented to customers in a user test in order to receive authentic feedback from the target group at an early stage. Again, an iterative process can be used to initiate a new build-measure-learn cycle. At the

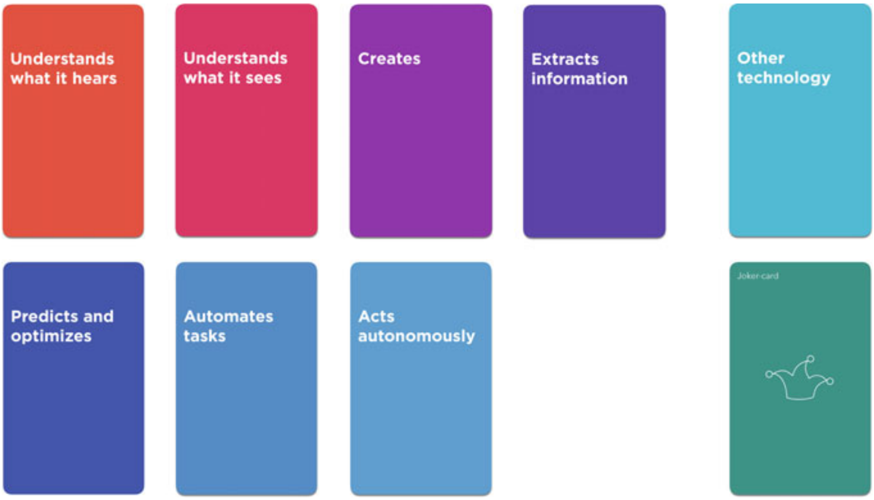

Fig. 10.13 AI Card Deck—overview of the categories. *Source* 33A (2019)

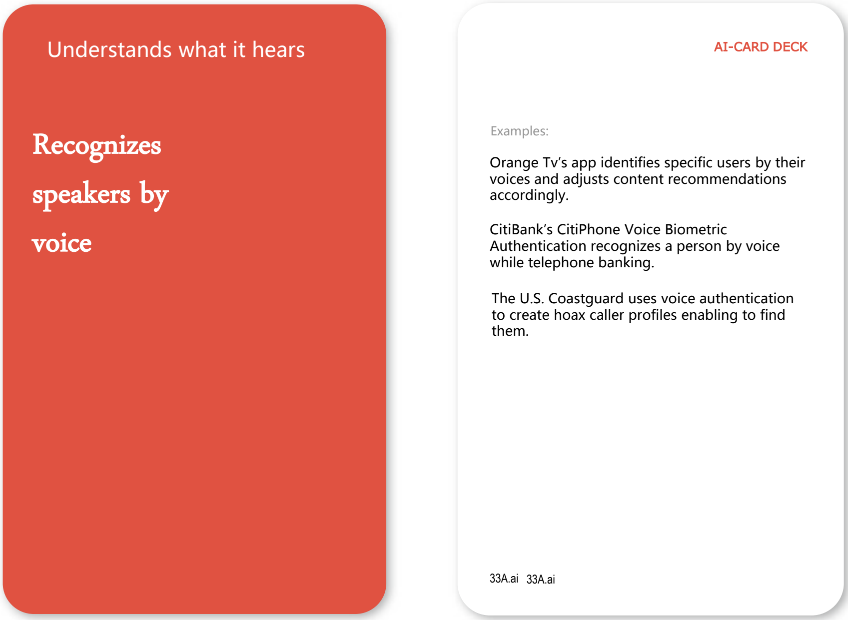

Fig. 10.14 AI Card Deck—example "Understands what it hears". *Source* 33A (2019)

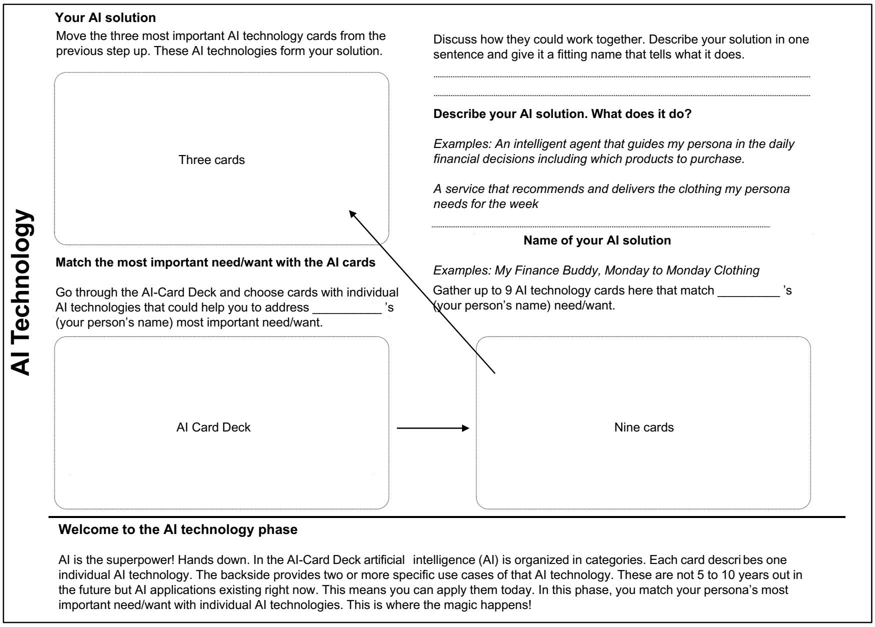

Fig. 10.15 AI Design Sprint—AI technology. *Source* 33A (2019)

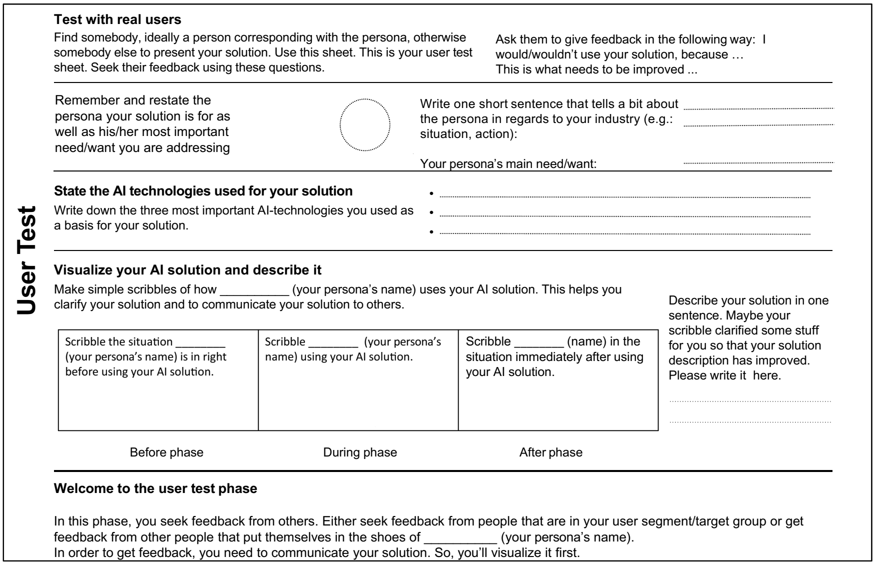

Fig. 10.16 AI Design Sprint—User Test. *Source* 33A (2019)

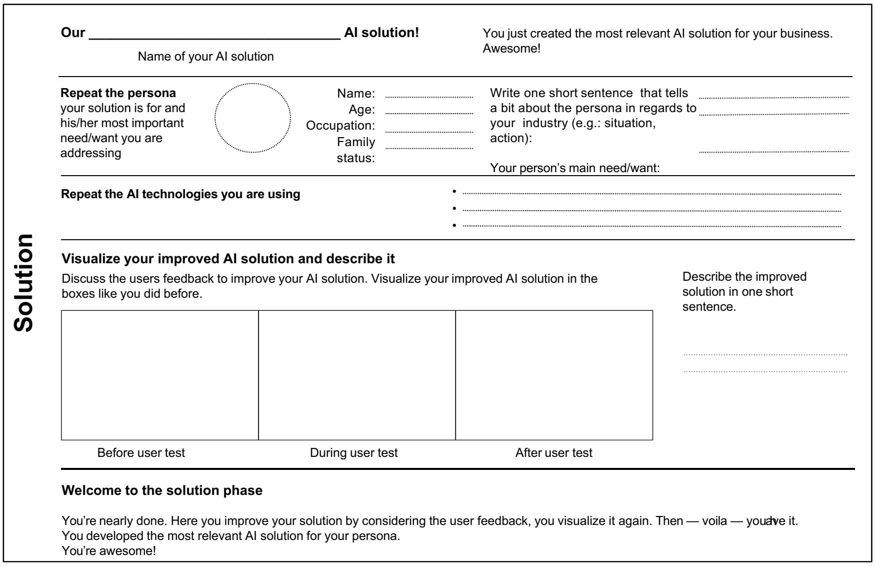

Fig. 10.17 AI Design Sprint Solution. *Source* 33A (2019)

latest after the successful completion of the development, the developed concept gets a name. These steps are documented in Fig. 10.17.

In the **Post-Session** you evaluate the developed AI concepts from different angles. AI experts examine whether the possibilities of Artificial Intelligence have been fully exploited in the solution. From an HR, production, purchasing and/or marketing perspective, it is determined how valuable the solution is for the target group of users. In addition, it is checked which costs, and which added value are associated with an implementation for the company.

Memory Box

The result of **the AI design sprint** is a **proven AI use case**. In addition, the required **data** and **data sources** were described. A **calculation** and a **time frame for the implementation** as well as a **definition of the process and personnel requirements** and a **business case** round off the proposal.

With a special **AI canvas**—here the **machine learning canvas**—the work processes of a company can be divided into individual tasks (cf. Fig. 10.18). Subsequently, it can be checked whether these can be replaced or supported by AI applications.

The **machine learning canvas** shown in Fig. 10.18 focuses on the desired **value proposition**. The core question is what the AI system can do for the user. The work can be oriented towards the following questions (cf. Dorard, 2016):

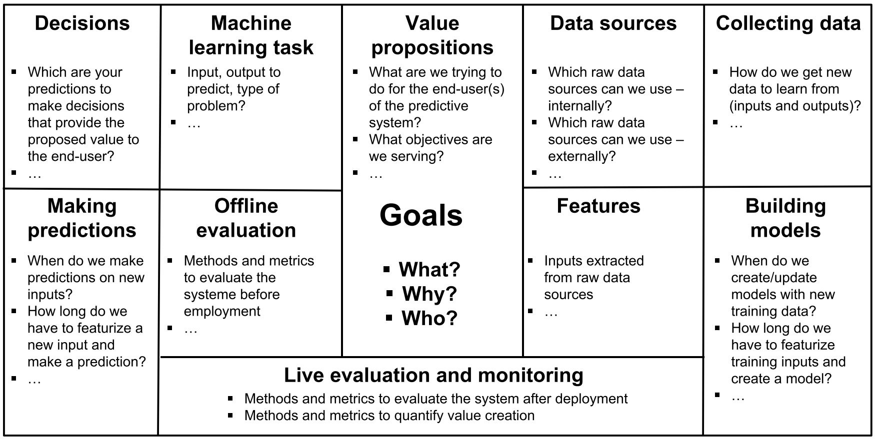

Fig. 10.18 Machine learning canvas. *Source* Adapted from Dorard (2016)

- **What**: Which tasks do we try to solve (better)?
- **Why**: What is the significance of the (better) solution?
- **Who**: Who is the user of our solution?
- **How**: How well can we predict—and what can we learn from it?

On the left side of the canvas is the **forecast part**. The following questions arise here:

- What **kind of decisions** should be supported? What added value can be achieved for customers?
- Which **machine learning tasks** have to be mastered? What input data is available, what output is expected and what kind of question is involved?
- What **kind of predictions** are to be made? How quickly do these have to be available?
- How can an **offline evaluation of the quality of result** be carried out before the systems are applied in practice?

On the right canvas page will find the **learning part**. The following questions arise here:

- What **external and internal data sources** can we use?
- How is **data collected** in order to obtain relevant new data on an ongoing basis—as input and output?
- Which particularly important **features and patterns** can be obtained from the raw data?
- When are **new/updated models** created when new trading data becomes available? How much time is available for this?

<table>
<tr>
<td rowspan="2">Important partners
▪ Social networks
▪ Suppliers
▪ Sales partners
▪ Data security organizations
▪ Lawyers
▪ …</td>
<td>Key activities
▪ Exploitation of different data sources
▪ Development of powerful algorithms
▪ …</td>
<td rowspan="2">Service promise
New products/services
▪ Chatbots
▪ Digital personal assistants as hardware (Alexa, Google Home etc.)
▪ …
New functions for existing products/ services
▪ Personalized and individualized recommendations
▪ Digital personal assistants as a service (Apple Siri, Google Assistant)
▪ …</td>
<td>Customer relations
▪ Retention of existing customers through new offers
▪ Greater exploitation of potential through individualized addressing</td>
<td rowspan="2">Customer segments
▪ Development of new customer segments through innovative solutions
▪ Increasing the conversion rate in customer acquisition through individual, personalized offers
▪ …</td>
</tr>
<tr>
<td>Key resources
▪ AI specialists
▪ Customer data
▪ Powerful algorithms
▪ Budget
▪ …</td>
<td>Distribution channels
▪ Digitization of the customer journey (online and offline)
▪ Achieving omni-channel communication
▪ …</td>
</tr>
<tr>
<td colspan="2">Cost structures
▪ Low costs for customer loyalty through an ecosystem with lock-in effect (increase in switching costs for customers)
▪ More cost-effective access to additional customer data
▪ Reduction of the number of employees in the service center
▪ …</td>
<td colspan="3">Revenue structures
▪ Higher exploitation of customer value potential through more-, cross- and up-sell measures
▪ Sale of new, supplemented products/services
▪ Development of further sources of income by marketing data (e.g. for advertisers)
▪ …</td>
</tr>
</table>

Fig. 10.19 Concept of the business model canvas for conversational Artificial Intelligence (Authors' own figure)

The lower part of the canvas is dedicated to **live evaluation and monitoring**. Here, you can see how the model has proven itself in everyday practice and what value it can add.

The machine learning canvas allows you to define the **challenge for your machine learning application** together with your team. This allows not only the approach but also the direction of the concept to be worked out and illustrated at the same time. The targeted value contribution is deliberately located in the center of the canvas (cf. Fig. 10.18).

Another exciting example of the use of canvas mechanics is shown in Fig. 10.19. In this **canvas for conversational Artificial Intelligence** it becomes clear in which areas Artificial Intelligence can achieve significant effects that directly affect cost and revenue structures.

In addition, you should use the **platform canvas** for your business. This allows you to check the extent to which your own business model is threatened by platform strategies of third parties and/or whether you have the resources to develop your own platform strategy (cf. in-depth Kreutzer/Land, 2015, 2016; Müller, 2017, pp. 186–190). When it comes to platform concepts, we often first think of B2C platforms such as *Airbnb, Amazon, Check24, Uber* & Co. In the meantime, various B2B platforms have also established themselves. These include the following examples:

- Alibaba (2019): Wholesales supply online; also rental of containers for transport
- CheMondis (2019): B2B online marketplace for chemicals
- Kaa (2019): Flexible open source IoT platform

- Mercateo (2019): Procurement platform for business customers
- MindShere (2019): Cloud-based open source IoT platform (*Siemens*)
- Ondeso (2019): Industrial automation management suite
- Predix (2019): Cloud-based platform as a service (*General Electric*)
- Scrappel (2019): Digital marketplace for recyclable materials
- Skywise (2019): Aviation's open data platform
- TOII (2019): IoT platform for connecting machines of different window manufacturers and generations
- Wucato (2019): Procurement platform for medium-sized industrial and craft enterprises.

Memory Box
What all these platforms have in common is that they act as a layer between the service providers and their customers. This creates **two-sided markets** that are advantageous for both suppliers and customers because many sellers are faced with many buyers. One speaks of positive network effects: Suppliers go where many demanders come together and demanders go where many suppliers are active. This often leads to the so-called **winner takes it all phenomenon** with platforms. This occurs when the platforms are highly scalable and offer "everything from a single source" in a certain market.

Providers take two major **risks** on such platforms. On the one hand, the platform operators learn exactly what is running and what is not running based on the transactions carried out. In this way, they build up a knowledge of the respective market that no one else has. On the other hand, they are severing the previously dominant direct customer-supplier relationships. Direct contractual partners are often the platforms—to the chagrin of the providers.

However, since such platforms are of great importance to customers, you should consider carefully whether you want to "play along" on such platforms or build your own platforms—with strong partners—yourself.

There is only one thing you should not underestimate: The importance of the platforms! Thinking and acting in platforms is the order of the day! It is therefore advisable to use the concept of a special **platform canvas** for your company as shown in Fig. 10.20. The first step in using this canvas is to work out the possible goals of a platform strategy for your company. One difference to the business model canvas is that you use this canvas to identify existing external platform operators that could endanger your business model. In addition, it must be examined which partners would be suitable for the development of their own or a common platform.

This makes it possible to focus the analysis on possible threats from platforms that are already established or under construction. At the same time, you start a creative process to identify possible goals for your own platform or a platform to be developed with partners. Finally, the potential partners that would be of interest for

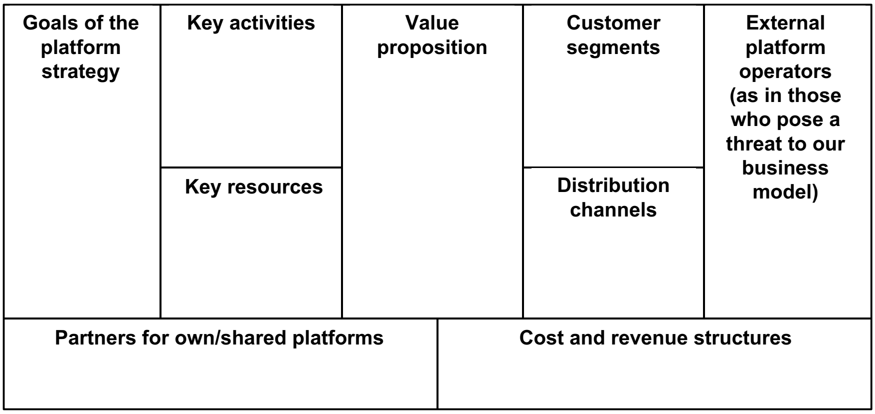

Fig. 10.20 Concept of the platform canvas (Authors' own figure)

such a solution are also examined. In that way, you can keep your finger on the pulse of threats from third party platforms.

Cross-functional AI task forces can be used for this purpose. It is necessary to continuously develop new AI application cases that are relevant for the business. Comprehensive internal and external cooperation is indispensable in these agile processes. The often-occurring **internal information silos** along the value chain—from research & development to purchasing, production, marketing and sales to controlling—have to be overcome systematically. **External information silos**—e.g. along the supply chain—must also be overcome in order to exploit the AI potential.

With these different approaches, it becomes clear that you need **qualified AI experts** in many places within your company in order to pursue your interests in the best possible way and over the long term. Then you no longer run the risk of being advised by the same AI agency as your competitors. It is important that at all times you are able to understand the AI system itself in order to **maintain control over the applications**. Keep the person as the final decision maker in the process as far as possible to ensure **cross-validation**. This makes it possible to switch off AI applications in order to avoid unwanted events. After all, AI-based decisions are only as good as the data basis and the algorithms used. For this reason, you should always work towards an **Explainable AI** for your applications that enables you to reproduce results (cf. Sect. 1.1). It is therefore essential that your AI applications express a self-assessment of the degree of imprecision of the forecast/decision made. This requires responsible engineering. Ensure 100% **user-friendliness** during development. Use the *Apple* principle, which is decisive for success, for this purpose:

Simplify! Simplify! Simplify!

Important assistance in the use of Artificial Intelligence can be provided by services such as **AI as a service**. This can be done using third-party systems, which are

trained accordingly for their own use cases (cf. Sect. 10.2 for approaches such as *Amazon SageMaker* and *Microsoft Azure*). Here, the critical point is that AI intelligence is not built up within the company itself. This entails the danger that decisions are based on AI systems whose algorithms are based on unreliable data and/or in which prejudices are programmed that are difficult to recognize. Some of these service providers offer the possibility to train their systems with their own data.

10.3.4 Phase 4: Integration of AI Applications and AI Results into the Company

The **integration of AI applications** as well as the **results achieved by Artificial Intelligence** presents every organization with more or less comprehensive challenges. There may be a **process re-design**. Based on new findings or new possibilities of process design, processes and procedures in the company can be questioned. Existing processes can be completely automated (e.g. for administrative, production and/or logistics tasks). The focus here is on the **machine-to-machine interface**. In other cases, human activities may be enriched by AI results. Here, relevant information can be made available to employees in the customer service center or maintenance area in real-time. This is the design of the **human-machine interface**—e.g. between digital assistants or expert systems and the employees in the company. In addition, Artificial Intelligence can be used to create **product and service innovations** or **develop new business models**. For this it is important that you **create an understanding for the following paradigm** in your company (cf. Govindarajan, & Trimble, 2010, pp. 10–14; Kreutzer, 2019, pp. 80–84):

- Today, the majority of (established) companies are only partially prepared for the development of groundbreaking innovations, which may even question their own business model, products and services. The heart of these companies is a so-called **performance engine**. This corresponds to an engine which purpose is to produce products and services of the desired quality reliably and with the highest possible degree of efficiency at defined costs—often in large quantities. Here, one can think of the assembly lines at *Volkswagen* and *Audi*, but also of production lines at *BASF, Henkel* and *Unilever*. In the performance engine, stability, predictability, routine and zero-error tolerance are the key success factors.

  The **performance engine** usually dominates the entire company. Therefore, all activities that run counter to the known pattern and cause uncertainty and inefficiency are blocked, undersupplied in terms of time and/or resources, or even completely shut down. From the point of view of the performance engine, these behavioral patterns are not unintentional misconduct, but the safeguarding of one's own success model. **Exploitation** of the existing business model is the name of the game.

- Today, this performance engine must be contrasted with a network-like concept that can react much faster to changes in the environment—and is allowed to do so. The term **innovation engine** can be used for this purpose. In this area, innovative projects of a radical and/or disruptive nature can be developed—independent of the core business of the company. The central guiding principles are open-mindedness of the business system, fault tolerance and the search for future strategically valuable business opportunities—independent of and unaffected by the company's own performance engine.
  An **innovation engine** does not necessarily have to be integrated within one's own organization—often it may not. The proximity to the operative business can prove to be counterproductive for the necessary creative process. It has proven itself many times that the installation of independent **innovation centers** for this task is necessary to identify exciting fields of application for Artificial Intelligence. The establishment of and/or participation in **independent AI companies** can also create the necessary creative freedom. At first, an innovation engine conceived in this way would only be relatively loosely connected to today's organization. The link between the corresponding investments would primarily exist at company law level.
  Within the innovation engine, various **task fields** can be defined. Here, work can be done on setting up a data ecosystem or on an AI platform to implement a new business model—without having to check at every step whether previous activities can be cannibalized with it. Here, above all, it is necessary to think outside the box of one's own company—detached from the limitations of the performance engine. **Exploration** dominates here.

Food for Thought

You can formulate an exciting **task for the innovation engine** in such a way that ideas and concepts are to be developed that would endanger or even destroy the business model of your own performance engine.

If you define such a task, you will soon encounter a lack of understanding—at least at the beginning. But don't your competitors—especially in the form of startups—act in exactly the same way? They look for weak points in your offer to attack there. Or they do cherry picking and try to extract the most profitable areas from your business model.

That's why it's better to do this work yourself, so that there are convincing solutions before potential competitors try to attack you. Because it's still true:

If you don't create the thing that kills us, somebody else will!

This requires the **resolution of the organizational dilemma**. Your task is to determine whether the desired and necessary **dualism** already exists in your company: On the one hand, there is the hierarchically-mechanistically structured management system of today's operative actions (in the sense of the **performance engine**). On the other hand, there are increasingly evolutionary and network-like

Performance engine	Innovation engine
(hierarchically structured part of the organization)	(network-oriented part of the organization)
▪ Well-defined and proven process and organisational structure ▪ Operational business management based on reliability, efficiency and zero errors ▪ Small steps are needed for change	▪ Work in the organisation is done with agility (innovation and speed) ▪ Management of projects with a radical, disruptive, possibly cannibalizing character ▪ Openness, fault tolerance, flexibility and speed are key requirements
Important: Here money is earned **today**!	**Important**: Here money will be earned **tomorrow**!

Fig. 10.21 Dualism in the transformation process (Authors' own figure)

structures to support successful innovation action (in the sense of the **innovation engine**). Here again, the relevance of the term **ambidexterity** described in Sect. 10.1 becomes visible.

To this end, you must determine the extent to which your organization can be developed in the long term in the direction of a **dual organization** with the parts described in Fig. 10.21 (cf. Kotter, 2014, pp. 20–24).

It has to be ensured that a **combination of performance and innovation engine** is not only given selectively, but that a **partnership-like cooperation** exists between both areas. A prerequisite for the success of this cooperation is that all employees of the two engines recognize the relevance of the other and value it. Only then can the **division of tasks between performance and innovation engines** be traced in their significance for the long-term survival of your company. In this way, new business ideas emerge in the innovation engine that are indispensable for sustainable corporate development. A prerequisite for this is the provision of the funds generated by the performance engine.

In order to be successful in this comprehensive process, the **corporate culture** and with it the **mindset** in the company must be developed. To this end, confidence in Artificial Intelligence and its results must be built up on a broad basis. The **Explainable Artificial Intelligence** described in Sect. 1.1has a significance that should not be underestimated. It should be borne in mind that people will need time to adjust to this paradigm shift. Consequently, great importance must be attached to the development of an **AI-capable culture**. This does not only require investments in the **development of skills of AI employees**. There is also a need to **invest heavily in middle and upper management** so that they understand the possibilities and limitations of Artificial Intelligence comprehensively—and do not prevent corresponding suggestions and ideas from their employees for fear of embarrassment (cf. McKinsey, 2017a, p. 34).

Memory Box
One of your biggest challenges is the internal **change management** to align the corporate culture with the possibilities of Artificial Intelligence. Why?

Culture eats strategy for breakfast (*Peter Drucker*)
It is therefore important that you involve all employees in the process of AI use at an early stage, rather than presenting them with a fait accompli—like a bomb-throwing strategy. You will only be successful with the best AI application if your employees develop a **digital mindset**. AI solutions often intervene in existing "areas" and therefore trigger strong defensive reactions (cf. Kreutzer, Neugebauer, & Pattloch, 2018, pp. 197–218).

It turns out that strong **support from the C-level** is indispensable for the successful use of Artificial Intelligence—as well as for the digital transformation of companies.

Food for Thought
Is the **mindset of your organization** already digital? It has to be, because Artificial Intelligence is not a singular IT project to be driven forward for a few years, but a strategic alignment of the entire company! And the AI impact will increase massively over the coming years—and will not leave out any division.

Memory Box
Companies are in demand to bring innovative AI-based business models onto the market themselves in order not to miss the leap onto the AI train. Don't wait for solutions from politics and research either.

Anyone who wants to make Artificial Intelligence a success must be agile, open and critical!
Develop your **own AI competence** early and comprehensively in exchange with representatives of science and industry. Through cooperation within and across industries, you can make the necessary investments. Design your **own legally compliant solutions** in exchange with politicians and invent **innovative products and services** in exchange with your customers!

Summary
The following **orientation points for the design of your AI journey** can help you to make this journey successful (cf. McKinsey, 2017b, p. 9):

- Identify interesting **AI fields of application** for your company.
- Set clear **priorities for selected use cases**—based on a clear business case.
- Don't put everything on an "AI horse"—diversify your investment risk without losing focus on **profitable business cases**.
- Develop your **own AI skills** internally (supported by external resources)—Artificial Intelligence will become a core competency and AI specialists are in short supply.

- Store a wide variety of data and access to data sources—**data is the fuel for AI value creation**.
- Make full use of your relevant areas of knowledge—only **special knowledge** enables the full use of the AI potential.
- The **first steps in AI transformation** are small and fast: pilot applications, tests and simulations.
- Large upfront investments are not necessary, but: **agility is key**!
- Check which of the presented **canvas concepts** can best help you with your AI journey.
- **Reinvest the resources freed up** by the use of AI in innovative business models —it's not a matter of "saving death", but of long-term competitiveness!
- The use of Artificial Intelligence requires a **cultural change** in your company— an openness for human-machine collaboration.
- Involve your employees at an early stage in AI concepts, engage in **active change management** and talk about emerging worries and fears.
- The **traceability of AI results** is not easy, but you should strive for it (**Explainable AI**).
- **Trust in AI results only grows over time!**

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Outlook

11

Abstract

In this chapter you will see that each society must adapt globally to disruptive changes caused by Artificial Intelligence! All nations, companies and people are in a constant metamorphosis process that has been triggered by digitalization and is further amplified by Artificial Intelligence. This process will not end anymore! Discussions as to whether Artificial Intelligence should generally be used or not are not conducive to success. The use of this technology worldwide can no longer be stopped. Active discussions on how to curb discrimination, abuse and misuse of AI systems are better. Artificial Intelligence should primarily be seen as an opportunity to overcome the continuing global challenges of increasing urbanization and mobility, radical demographic changes and global climate change. The Internet knows no boundaries—Artificial Intelligence knows no boundaries, too!

11.1 Time Horizons of Possible AI Developments

A look at the short-, medium- and long-term developments should provide information on the direction in which Artificial Intelligence will develop (cf. Fig. 11.1). Use these forecasts as an orientation to get a rough idea of the **AI breakthroughs** to come. Here, the following applies: the further we take a look into the future, the more speculative the statements become.

Memory Box
AI development can quickly move in a different direction when new technological breakthroughs are achieved!

In the **present**, it is particularly important to quickly recognize and use the already existing possibilities of Artificial Intelligence. Important fields of application are the **standardized, repetitive and scalable tasks** shown in Fig. 11.1.

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Management for Professionals, https://doi.org/10.1007/978-3-030-25271-7_11

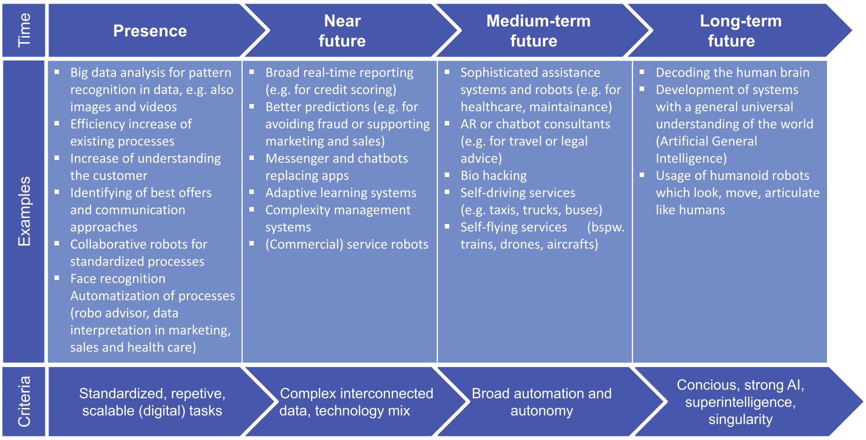

Fig. 11.1 Time horizons of possible AI developments (Authors' own figure)

Parallel to this, (further) data sources must be developed in order to feed the AI systems with the relevant data streams.

Over the **next few years**, a wide variety of technologies will be integrated with **AI applications in many production and service processes**. In addition, it is becoming easier and easier to feed the AI programs with a multitude of unstructured data from various sources. Improved results and predictions make it possible to handle even more complex cases and develop ever more powerful systems. Then the assistance systems under discussion will be able to deal better with natural language and provide more relevant information than they do today.

We can expect **high-impact automation processes** within the **next few decades**. Human-machine cooperation will become more and more important and will disrupt many industries! This applies especially to the areas characterized by the analysis of documents or other highly repetitive, administrative, but still intellectually demanding tasks. The jobs of accountants, service center employees, marketing specialists, tax consultants, bank employees and insurance brokers are particularly at risk.

Whether this expected development should be cause for concern depends on one's own initial situation. If AI systems are used for sustainable **cost reduction**, comprehensive job losses are to be expected—possibly with a simultaneous increase in corporate profits. If, on the other hand, AI systems are used to better care for, support and cooperate with people, the quality of life can be sustainably improved (cf. Decker, 2017, p. 21).

In any case, there will be a comprehensive shift in competence—just like in the previous industrial revolutions! In future, the focus will be on skills such as managing change, developing new concepts and implementing them (cf. Schwab, 2016, p. 63). The IBA Global Employment Institute (2017, pp. 27–32) has published a report on the impact of Artificial Intelligence on the workplace.

They concluded that jobs with low and medium qualifications as well as those for simple physical tasks would be eliminated. In return, there will be a significant increase in the **demand for highly qualified data scientists** to cope with the increasing flood of data. At the same time, the number of **crowd workers** and **click workers** will increase significantly. These terms are used to describe persons who accept work orders that are offered to a large number of people via online platforms. These people apply online for the presented orders and work on them alone or with other people. They're primarily on a freelance basis.

This gap in employment relationships, which is only hinted at here, can tend to lead to a **division of the working population**. While highly qualified employees are in secure working conditions and can easily apply from company to company because of their qualifications, crowd workers are more likely to be on the losing side. They are moving from order to order—not knowing when the next project will be won. No long-term life decisions can be made on this basis.

At the same time, significant **added value potential of Artificial Intelligence** is expected in various sectors (cf. Fig. 11.2). McKinsey (2018b, p. 13f) estimates that the potential value contribution of Artificial Intelligence will be between one and

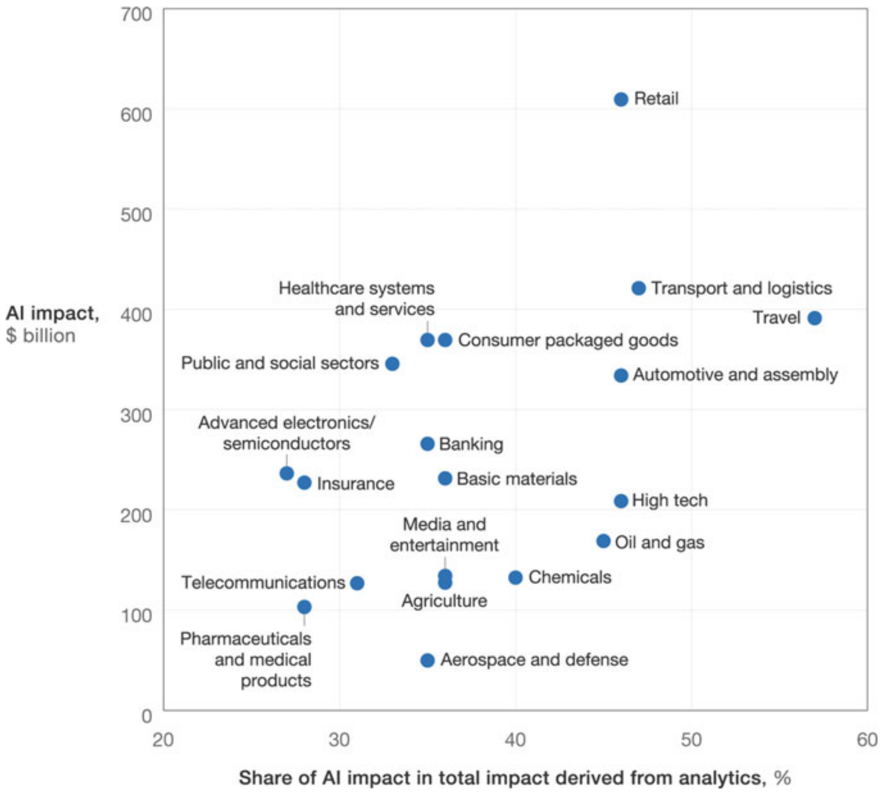

Fig. 11.2 Value-added potential of artificial intelligence in various industries. *Source* McKinsey (2018b, p. 13f)

nine percent of industry sales in 2016. This value varies considerably from industry to industry and depends on the specific application possibilities, the availability of extensive and complex data as well as regulatory and other restrictions.

The figures presented in Fig. 11.2 are not forecasts for a specific period; rather, they are intended to illustrate the considerable **AI potential of the global economy**. The greatest impact can be found in the marketing and sales functions as well as in the areas of supply chain management and production. The consumer goods industry (here retail and high-tech products) has greater potential in marketing and sales AI applications. One reason for this is the more frequent and often digital interaction between companies and customers. The resulting larger amounts of data provide an exciting field of application for AI techniques. E-commerce platforms in particular can benefit from this. This is helped by the fact that such platforms can easily capture customer information (such as click data or time spent on a website). Thus, promotions, prices and/or product and service offers can be developed individually for each individual customer in real-time (cf. McKinsey 2018b, p. 13f.; cf. Sect. 4.2).

Figure 11.3 shows ideas as to which **AI fields of application** could be particularly exciting for your company. A study by Capgemini (2017, p. 12) analysed over 50 AI use cases. It has been shown that many companies start their AI journey with the most difficult use cases. In contrast, only a few focus on applications that are not only easy to implement, but also highly beneficial. In order to avoid these errors, AI applications were grouped according to the extent of their complexity and the extent of the benefit creation (cf. Fig. 11.3).

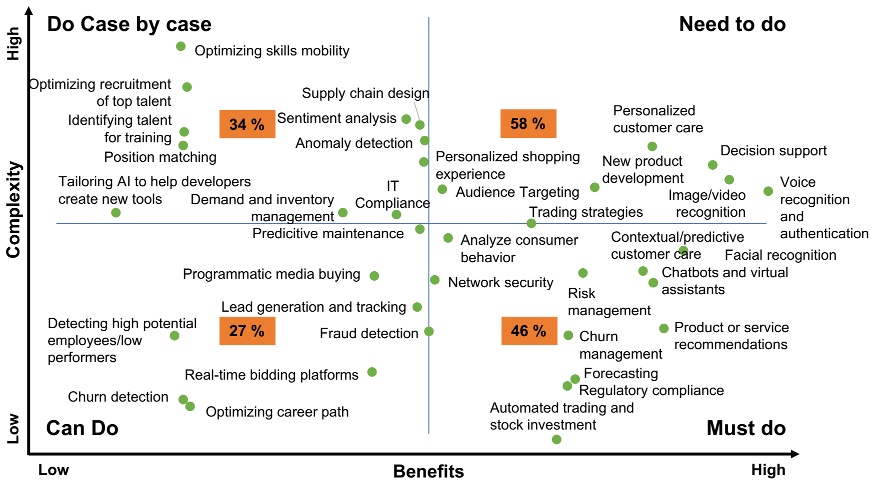

Fig. 11.3 AI use cases according to the extent of the benefit creation and the degree of complexity. *Source* Based on Capgemini (2017, p. 12)

Must do applications are those that provide a high degree of benefit, but at the same time are associated with a low level of complexity in the application. This is where 46% of the internationally active companies surveyed concentrate. These include the analysis and prediction of customer behavior, risk management, the use of facial recognition and chatbots or digital personal assistants. The AI-supported product and service recommendations also fall into this area. **Can do applications** (little benefit creation with low complexity) account for 27% of use cases. This includes the optimization of career plans and churn recognition.

Do case by case applications provide little benefit at a high level of complexity. In each individual case, it must be checked whether a corresponding AI investment is worthwhile. Nevertheless, 34% of the identified use cases concentrate on this area. Here processes in the area of human resources should be considered. The focus of the use cases examined by Capgemini (cf. 2017, p. 12) is on **need to do applications**; here a high benefit endowment coincides with a high degree of complexity in the application. This includes individualized customer care, decision-making systems and the development of new product and service concepts.

Memory Box
Your company is faced with the question of what must do, can do, do case by case and need to do applications are for you. Figure 11.3 can help you with your decision—and represents a thought impulse for it. You must carry out the corresponding evaluation for your company by yourself.

The ***Open AI* project** can make a contribution to anchoring Artificial Intelligence more comprehensively in society, business and science. It is a non-profit AI research company supported by individuals (such as *Elon Musk* and *Peter Thiel*) and companies (such as *Amazon, Infosys, Microsoft* and the *Open Philantropy Project*). The company has defined the following in its mission (Open AI, 2018):

> Artificial general intelligence (AGI) will be the most significant technology ever created by humans.
>
> Open AI's mission is to build safe AGI, and ensure AGI's benefits are as widely and evenly distributed as possible. We expect AI technologies to be hugely impactful in the short term, but their impact will be out-stripped by that of the first AGIs.
>
> We're a non-profit research company. Our full-time staff of 60 re-searchers and engineers is dedicated to working towards our mission regardless of the opportunities for selfish gain which arise along the way.
>
> We focus on long-term research, working on problems that require us to make fundamental advances in AI capabilities. By being at the fore-front of the field, we can influence the conditions under which AGI is created. As Alan Kay said, 'The best way to predict the future is to invent it.'
>
> We publish at top machine learning conferences, open-source software tools for accelerating AI research, and release blog posts to communicate our research. We will not keep information private for private benefit, but in the long term, we expect to create formal processes for keeping technologies private when there are safety concerns.

Through events, research activities, publications and a blog, *Open AI* aims to support the debate on Artificial General Intelligence—for the benefit of all!

How intensively we let Artificial Intelligence penetrate our lives depends on ourselves. However, the increasing complexity forces not only companies, but also every single person to make use of different AI-based solutions. Many people already do this today without being aware of it. *Google* hit lists, recommendations from *Amazon, Netflix, Spotify* and Co. would be less convincing without the use of Artificial Intelligence. At the same time, it is good that AI systems support quality production and ensure that an almost worn part of an aircraft turbine at its destination in New York is replaced immediately due to predictive maintenance before the turbine fails. We are often already beneficiaries of Artificial Intelligence—often without knowing it.

Against the background of these complex tasks, it is not sufficient to concentrate solely on the ethical challenges of Artificial Intelligence. Nor should we use all our creativity to play through disaster scenarios from robots running out of control. Much more realistic are scenarios of humanoid robots like *Pepper* running perfectly, playing *Go*, diagnosing disease, organizing business trips, and recognizing and responding to our mood. Science fiction films can help our imagination by exploring possible future scenarios through thought games.

Food for Thought
Many of the fears associated with Artificial Intelligence stem from the fact that we fear a **loss of control** because we can no longer understand why something is happening. If we are honest, we accept this loss of control in a variety of applications—every day. Who—apart from the respective specialists—can explain exactly how a combustion or diesel engine works, how a solar power plant generates energy, how the *Google* search algorithm is structured and how the processes in a smartphone work that we take into our hands every day? And yet we still use and trust these systems—24/7!

Memory Box
There will be no human future without Artificial Intelligence, just as there will be no everyday life without electricity or without the Internet.

11.2 Challenges for Politics and Society

What are the **challenges for politics and society** posed by the ever-increasing advance of Artificial Intelligence? In addition to companies, politicians have a major responsibility to ensure that the journey to the world of AI has its advantages rather than its disadvantages. The 1st phase should be analogous to the one in the companies AI journey: informing yourself is indispensable—ideally through dialog with the movers and shakers!

It is more important than ever for politicians to comprehensively assess the **effects of AI technologies** in the exchange with science and industry. However, not only the risks, but above all the opportunities should be the focus of attention—despite all hostility to technology, which is too often to be seen. Therefore, the focus should not lie solely on the question of how many jobs are threatened by Artificial Intelligence. Rather, it should be asked how Artificial Intelligence can contribute to the further intelligent and healthy growth of our economy!

There are often calls for a digital ministry in order to correctly classify the increasingly complex interrelationships between digitalization, industry/economy 4.0 and Artificial Intelligence and to be able to make politically responsible decisions. In our opinion, such an institution is indispensable if the issue is to be taken seriously at the political level. In any case, splitting responsibility between different ministries does not make sense.

Memory Box

If everyone's responsible, nobody's responsible!

That also applies to politics!

In addition, it is the duty of politicians to pass on this knowledge to the population through appropriate **orientation of educational work**, in order to promote the development of digitally responsible citizens. **Education** plays a key role not only in attaining AI competence, but also in counteracting the increasing development of inequality. There is a real **race between technology and education** (cf. Goldin & Katz, 2010). Those who have early access to new technologies that go beyond mere operation and create application competence are better able to apply these skills in their professional lives and counteract the threat of unemployment. Digital learning tools such as MOOCs create individual learning experiences and provide data for feedback—not just for pupils and students but for the entire education system—and trigger a continuous improvement process.

To this end, a constructive political initiative must be strengthened in order to **promote a social debate on the subject of Artificial Intelligence**, so that fears and anxieties can be taken seriously and ideally overcome. Otherwise, the discussion is left to conspiracy theorists and doomsayers who direct their horror visions towards an (uninformed) audience.

Memory Box

Politics and business should work together for a **culture of transparency and trust in Artificial Intelligence**. This is the best breeding ground for the necessary spirit of optimism!

In addition, a **re-skilling initiative** is needed in order to impart the relevant core competencies for the digital working world to career starters and those who are already working. What is needed is a **curriculum for digital education**—from schools and the professional training system to colleges and universities (cf. Bendiek, 2018, p. 72).

In addition, intensive **cooperation between science and industry** must be promoted so that not only outstanding research achievements are gained, but these also flow into marketable products and services. This cooperation should also include medium-sized companies that may not have the necessary budget for comprehensive AI research.

Job placement support is another important policy area to reduce costs for workers and employers and to get the right skilled workers quickly to the right jobs. Personal recommendation from the employee's network is still the best way to find a lucrative job. Powerful AI systems to determine the competencies of applicants can facilitate a quick comparison with employers' requirements. Politicians have a responsibility to promote the development of effective data banks—preferably in an international context.

The long-term **workplace effects of AI use** must be examined holistically. The more automation and thus the replacement of work progress, without simultaneously creating the same number of new jobs, the more difficult it will be to achieve and maintain full employment. It is not necessarily wealth that is diminishing, but its distribution in the population as a whole will change. The task of forward-looking government action is to ensure, in the course of the entire debate on digitalization, that Artificial Intelligence also serves the society as a whole and does not only increase the profits of individual people or companies.

Memory Box
The comprehensive society must be aware of what Artificial Intelligence means and where ethical boundaries should be set. At the same time, an awareness must be created of the contribution that Artificial Intelligence can and must make to shape the future, so that America and Europe do not lose touch here.

In addition, policymakers must develop a binding **legal framework** on issues such as security and data protection. Many companies that already have AI applications are in grey areas because many digital processes do not yet have regulations. A first step is the new General Data Protection Regulation (GDPR), which sets very narrow limits for the use of AI in many areas. The challenge is to strike a balance between the **social goal of protecting personal data and the availability of high-quality training data for AI algorithms**.

Food for Thought
The GDPR made it considerably more difficult for European companies to access personal data (e.g. from interested parties and customers). US-companies such as *Amazon, Facebook* and *Google* will maintain their competitive advantage, as will corresponding Chinese companies such as *Alibaba, Baidu*, *JD.com* and *Tencent*.

The situation is different with data obtained in the context of industry 4.0. Through the Internet of Things or the Internet of Everything, a lot of data is obtained that is not subject to the GDPR. This offers European companies exciting fields of activity which they must actively address.

It is up to the government to create a balance between **regulatory necessity** and **scope for innovative business models**. Like any company, each country must decide for itself where it wants to play in the AI league and what **state investment support** is granted. China is determined to lead the world league of Artificial Intelligence instead of just swimming with it.

An important task for a AI master plan is the **development of a startup ecosystem** in which AI-focused companies can be established. According to a study by Roland Berger (2018, p. 7), almost 40% of all AI startups are located in the USA. Europe as a whole is in second place—ahead of China and Israel. Not a single European country has a sufficient critical mass of AI startups. Great Britain is in 4th place for AI startups, France in 7th place and Germany in 8th place.

The comprehensive use of Artificial Intelligence creates many opportunities—but is also associated with great challenges in its implementation. The advantages of Artificial Intelligence only become apparent in the longer term; therefore, the advantages of initial investments are not immediately apparent. Thus—in economy, politics and society—not only patience, but also a **long-term strategy and thinking of politicians and managers over election periods and contract terms** are necessary. Political and economic decision-makers alike must assume a clear leadership role in order to successfully shape the transformation process and overcome obstacles. The fear of losing one's job must be taken just as seriously as the danger of falling behind worldwide if AI technologies are ignored.

In order for individual countries to benefit from the use of AI, the following questions need to be answered (cf. McKinsey, 2018a, p. 47):

- Which **investments in AI technologies** are advantageous for the development of competitiveness and at the same time create new jobs?
- How can political decision-makers further develop **educational offers and systems** in such a way that comprehensive knowledge about the possibilities and limits of Artificial Intelligence is imparted?
- How can it be ensured that there will be higher **government investment in national human capital**?
- How can the foreseeable **changes on the labour market** be made socially acceptable (e.g. through concentrated action between government, companies and trade unions)?
- How can **healthy competition between companies** be promoted in order to avoid a development towards AI monopolies following the winner takes it all effects (analogous to search engine and social network monopolies)?
- How can the **legal framework conditions** (e.g. for new forms of work and for the use of data) be designed in such a way that the transformation process can take place in a legally secure manner?
- How can **copyright** be designed in such a way that AI systems are also recognized as creators of creative solutions—and not just people?

- What solutions can be used to provide **financial security for people** if significant employment deficits and associated unemployment occur as a result of the use of AIs (to promote mobility, training measures, conditioned/unconditional state transfers)?
- How and to what extent can **global AI standards** (e.g. military borders, data protection or generally valid value images of AI algorithms) be defined?

It will take even longer for a majority of companies to experience an **AI first strategy**. Unfortunately, too many companies are still struggling to cope with their digital transformation in order to tackle the next stage of development today—the comprehensive integration of Artificial Intelligence. This is very worrisome because it does not address future challenges!

Food for Thought

> Those who want to have a say in how far technology dominates the world first have to dominate technology itself (Jung, Nezik, Rosenbach, Schulz, 2018, p. 67).

Summary

- Each society must adapt globally to disruptive changes caused by Artificial Intelligence! We are in a **constant metamorphosis process** that has been triggered by digitalization and is further amplified by Artificial Intelligence. This process will not end anymore!
- Discussions as to whether Artificial Intelligence should generally be used or not are not conducive to success. The use of this technology worldwide can no longer be stopped. **Active discussions** on how to curb discrimination, abuse and misuse of AI systems are better.
- Artificial Intelligence should primarily be seen—also by us—as an **opportunity to overcome the continuing global challenges** of increasing urbanization and mobility, radical demographic changes and global climate change.
- An international initiative is needed to develop a **global AI guideline** that creates a binding orientation framework for all countries. The **Internet knows no boundaries—Artificial Intelligence knows no boundaries**, too! In such a guideline, topics like the general security and acceptance of Artificial Intelligence, a positive human-machine cooperation as well as the effects of automation on our society can be considered.

This assessment may help us to achieve the necessary **composure as citizens for dealing with Artificial Intelligence**:

> Our intelligence has been trained over millions of years of evolution, and it is tailored to look everywhere for explanatory patterns to protect us from danger. Therefore, it is not important that we function mathematically precise. A high degree of chance determines our human intelligent thinking. In other words, as spiritual beings we are free precisely because there is no universal algorithm that our thinking follows. We are not completely

programmed by anything and nobody. This is why we are only partially predictable, because we constantly make smaller and larger mistakes for which no program can be written (Gabriel, 2018a, p. 21; continuing Gabriel, 2018b).

It will therefore take a very long time before even an approximate replica of the human brain can be created. The journey there will be accompanied by a multitude of changes in our private and professional lives.

We wish all our readers the necessary courage and self-confidence to cope with them constructively and courageously!

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Index

0-9
3-horizon model, 235, 243
3-horizon model for strategic analysis of AI integration, 236
5G mobile network, 81
24/7 monitoring of the residents, 200
100-Qubit computer, 80
360° view of the markets, 150
1-800-Flowers, 112

A
Accepted fields of application of chatbots, 114
Accepted fields of application of social bots, 115
Acrolinx, 142, 143
Acrolinx platform for content creation, 143
Activities of conversational commerce, 133
Activity tracker, 172
Ada, 173
Ada health platform, 174
Adaptability, 9
Adapted learning, 185
Added value potential of Artificial Intelligence, 277
Adgorithms, 132
Admission control for employees, 33
Adobe, 219
Advantages of an AI-based smart factory, 96
Advantages of using AI for armaments, 231
Advice expert system, 111
Aggregated reviews, 139
AI application areas, 87
AI applications, 239
AI as a service, 267
AI-assisted surgery, 175
AI-based dialog, 123
AI-based measurement of customer satisfaction, 110
AI-based shelf monitoring, 157
AI basics, 239
Albert AI platform, 132
AI breakthroughs, 275
AI budget, 239
AI canvas, 263
AI-capable culture, 270
AI Card Deck, 259
AI Card Deck—example “Understands what it hears”, 261
AI Card Deck—overview of the categories, 261
AI challenge, 235
AI competence team, 242
AI-controlled optimization of logistics processes, 100
AI critics, 19
AI Design Sprint—AI technology, 262
AI Design Sprint Method, 259
AI Design Sprint—Needs and Wants, 260
AI Design Sprint—Persona, 260
AI Design Sprint—Solution, 263
AI Design Sprint—User Test, 262
AI-driven price agreements, 140
AI employees, 239
Alexa, 107
Alexa—Google Assistant, 122
Alexa Skills Kit, 121
Alexa Skill TK Smart Relax, 171
AI-first company, 81
AI first strategy, 284
Algorithmic cartels, 141
Algorithmic trading, 214
AI hub, 242
AI-induced wealth creation, 51
AI intoxication, 16
AI journey, 242
AI leaders, 47
Ailira, 111
AI maturity, 238

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AI maturity map, 238, 239
AI penetration, 79
AlphaGo, 15
AI potential of the global economy, 278
AI platforms for media planning, 132
AI-supported education, 179
AI-supported human resource management, 186
AI-powered diagnostic tools, 177
AI-related analysis of the value chain, 155
AI strategy, 239
AI-supported analyses and forecasts, 179
AI-supported assessment of content, 143
AI-supported content creation, 143
AI-supported content distribution, 143
AI-supported developments in healthcare, 176
AI-supported film production, 215
AI-supported "new creations", 215
AI-supported sentiment recognition, 137
AI system for voice analytics, 109
AI systems, 239
AI targets, 239
AI to achieve predictive maintenance, 163
AI use cases according to the extent of the benefit creation and the degree of complexity, 278
Amazon Echo (*Alexa*), 116
Amazon Go, 157
Amazon Rekognition, 146, 147
Amazon Rekognition Video, 147
Amazon SageMaker, 247, 268
Ambidexterity, 237, 270
Ambient Assisted Living (AAL), 201
Analysis and optimization of websites, 132
Analysis of customer conversations, 110
Analysis of the AI maturity, 241
Analysis of the existence of AI applications, 240
Analysis of the existence of the AI basics, 239
Analysis of the patient's medical history, 177
Angelina Jolie effect, 171
Anticipating shelf refilling, 157
Anticipatory shipping, 156, 164
Appeal, 26
Apple Watch, 174
Application process, 189
Argument mining, 137
Arguments for reshoring, 101
ArgumenText, 137, 138
Ars Electronica, 219
Ars Technica, 215
Artificial birth of digital twins, 170
Artificial General Intelligence (AGI), 49, 72, 138
Artificial Intelligence, 1, 3, 8
Artificial Intelligent muse, 221
Art-on-demand, 222
Asset management, 213
Associated Press, The, 141
Assortment design, 155
Attribution modeling, 131
Audio coaching, 172
Augmentation, 48
Augmented Reality (AR), 185
Augmented reality glasses, 186
Augmented reality systems, 78
Augmented writing, 189
Automated creation of texts, 141
Automated customer service, 107
Automated Guided Vehicles (AGVs), 93
Automated image recognition, 181
Automated Insights, 142
Automated quality control, 99
Automatic payment, 157
Automation of labor, 49
Autonomous AI-based diagnostic devices, 177
Autonomous decision making, 13
Autonomous dialog guidance, 127
Autonomous drones, 157
Autonomous driving level 4, 72
Autonomous driving level 5, 72
Autonomous flying aircrafts, 72
Autonomous flying vehicles, 72
Autonomously driving car, 40, 205
Autonomous robots, 97
Autonomous shopping cart, 156

B

Bank of America, 212
Barack Obama, 220
Basic components of robots, 37
Basics and drivers of Artificial Intelligence, 59
BAT companies, 44, 129
Benjamin, 215
Better@Home, 201
Bettermarks, 180
Big data, 64
Biochips, 76
Biohacking, 75
Biotech, 76
Bixby, 116
Blended learning, 180, 184
Bodyhacking, 63, 75
Bot Engine Optimization (BEO), 129
Brain computer, 72
Brain Computer Interface (BCI), 72, 73
Brain Machine Interface (BMI), 72
Build-measure-learn cycle, 257

Business model canvas, 244
Business model innovations, 237

C
Camelyon Grand Challenge 2016, 169
Campaign film *Driven by Intuition*, 215
Can do applications, 279
Canvas concept for the use of Artificial Intelligence, 245
Canvas for conversational Artificial Intelligence, 265
Canvas for the use of Artificial Intelligence, 245
Cardiogram, 174
Care and provision of the ageing population, 200
Carnegie Cognitive Tutor, 180
Carnegie Speech, 180
Car-to-car communication, 203
Cashless shopping experience, 157
Cat people, 158, 159
Centauro, 231
Challenges for politics and society, 280
Characteristics and principles of Design Thinking, 248
Chatbot economy, 135
Chatbots, 30, 107, 111
Chatbots for proactive (general) communication, 112
Chatbots for proactive (individualized) communication, 112
Chatbot software, 127
Chatbots to optimize customer-initiated communication, 111
Chatbot *Tay*, 113
Chat of an e-commerce conversation app, 134
Chess, 14
China, 46, 226
Cisco, 92
Classic robots, 36
Classification of robots according to fields of application, 36
Classification of robots according to the degree of their “human appearance”, 37
Classification of robots according to the degree of their interaction with humans, 36
Classification of robots according to their degree of mobility, 36
Collaborative robots (cobots), 37, 71, 97, 98
Collusive behavior, 140
Combat robots, 230
Communication square, 25
Component for solution communication, 35
Component for the development of problem solutions, 34
Components of expert systems, 34
Computer games, 216
Computer vision, 30
Computing power, 77
Concept of the Minimum Viable Product (MVP), 253
Concept of the platform canvas, 267
Congenial re-creations, 215
Content AI service, 139
Content creation, 141
Content generation, 142
Content marketing, 131, 142
Content shock, 142
Context-aware robots, 98
Context-based services, 135
Context marketing, 131, 135
Contextualized and personalized experiences, 78
Contract intelligence platform, 212
Controlling of the chatbot deployment, 128
Conversation AI platforms, 72
Conversational commerce, 133
Conversational interface, 111
Conversational User Interfaces (CUIs), 72
Coreference resolution, 29
Core of Artificial Intelligence, 2
Cortana, 116
Corti AI system, 169
Costs and negative effects of the transition to an AI-based economy, 52
Costs and other negative effects of AI use, 51
Course of the Design Thinking process, 249
Creating voices, 219
Creation of own AI competencies, 242
Creative counterfeits, 220
Creative sector, 215
Credit and insurance business, 212
Credit scoring, 212
Credit-Sesame-App, 227
Crispr, 171
Criticism of social scoring, 228
Cross-border data flows, 51
Cross-functional AI task forces, 267
Cross-sectional technology, 23
Culture of transparency and trust in Artificial Intelligence, 281
Cumulative overall effect, 51
Curriculum for digital education, 281
Customer experience, 107
Customer touchpoint tracking, 131
Cyber-Physical Systems (CPS), 90, 91
Cyber security, 197

Cyborg, 63
Cyborg pioneers, 77

D

Dark processing, 212
Darmstadt, 203
Data and process ecosystem, 94
Data diversity, 137
Data-driven recruiting, 190
Data ecosystem, 246
Data gaps, 45, 245
Data scarcity, 68
Data silos, 94
Data sovereignty, 129
Death algorithm, 20
Decentralized early detection and diagnostics, 177
Deep Blue, 14
Deep fakes, 178, 221
DeepL, 222
Deep learning, 71
DeepMind, 196
DeepMind Health, 174
Deep learning, 8
Deep Neural Nets, 71
Definition of the target corridor for the use of AI, 242
Dehumanization of warlike conflicts, 232
Delegated decisions, 13
Delegation of decisions to AI systems, 13
Delivery by drone, 208
Demand for jobs, 47
Dematerialization of products, services and processes, 60, 61
Democratized Artificial Intelligence, 71
Depth of the model, 6
Description, 3
Design challenge, 252
Design of space and time of the Design Thinking process, 250
Design Phase of AI applications, 259
Design Thinking, 248
Detection of false information, 149
Detractors, 110
Deutsche Bank, 213
Deutsche Familienversicherung, 212
Development of an AI journey, 242
Development of a startup ecosystem, 283
Development of new car purchases, 205
Development of powerful algorithms, 242
Development of the data volume, 66
Development to an intelligence explosion, 17
Developments in retail, 155
Development towards an autonomous vehicle, 207
Diagnostic-supporting application, 169
Dialog agents, 28
Dialog paths, 127
Digital assistance systems, 186
Digital assistants, 116
Digital brand touch point, 119
Digital butlers, 122
Digital competence, 186
Digital Darwinism, 69
Digital data flows, 50
Digital health applications, 178
Digital identification mark, 31
Digital (information) value chain, 94
Digitalization, 60
Digitalized Ecosystems, 74
Digital learning platforms, 179
Digital ministry, 281
Digital object recognition, 157
Digital personal assistants, 116, 119
Digital personal language assistants, 119
Digital shadow, 213
Digital signature, 130
Digital twins, 75, 170, 177
Digital value chain, 94
Digitsole, 172
Disadvantages of an AI-based smart factory, 96
Distribution of digital personal assistants, 117
Division of labor between human and mechanical action, 12
Division of the working population, 277
Do case by case applications, 279
Doctor App, 173
Dog people, 158, 159
Do-it-yourself biohacking/bodyhacking, 75
DoorDash, 208
Dota 2, 216
Drivers of Artificial Intelligence, 59, 60
Drone-based delivery, 208
Drones for logistics applications, 208
Dualism, 269
Dualism in the transformation process, 270
Dual organization, 270
Duolingo, 180
Duplex, 123
Dynamic pricing, 140
Dynamic profiling, 131
Dynamics of changes in professional life, 183

E

Ear-to-ear, 133
E-commerce conversation app, 134

Economic effects of Artificial Intelligence, 41, 42
Economic use of AI-based automation and innovation, 53
EDAN, 175
Edge AI, 79
Edmond de Belamy, 219
Effects of AI technologies, 281
Effects of exponentiality, 60
Effects of smart manufacturing, 96
Elderly Care, 201
Electroencephalography (EEG), 73
Electronic whiteboards, 78
Emma, 112
Emotional analysis for retail, 146
Empathize, 250
Empathy map for a persona, 251
Empathy maps, 251
Employment dynamics, 53
End-to-end data solutions, 94
Energy sector, 195
Entry and exit points, 127
ePuzzler, 222
Erica, 212
Establishment of a data ecosystem, 245
Establishment of an own data ecosystem, 242
Ethical challenges of Artificial Intelligence, 280
Ethical goals, 20
EU Commission, 81
European Union, 45
Evaluation of images, 31
Evaluation of written performances, 183
Everything as a service, 78
Exoskeletons, 76
Expectation matrix of customers and companies, 105, 107
Expert systems, 23, 34
Explainable Artificial Intelligence (XAI), 11, 12, 267, 270
Exploitation, 237, 268
Exploration, 237, 269
Exploration and military robots, 36
Explosion of intelligence, 18
Exponential growth, 60
External image, 241
EyeQuant, 132

F
Facebook, 124
Facebook Messenger, 112
Face++, 225
Face++ Cognitive Services, 225
Face recognition, 145, 146, 184, 225, 226
Face-to-face, 133
Facial analysis, 146
Facial recognition, 9
Factual information, 26
Fairness of Artificial Intelligence, 10
Fake and fraud detection, 213
FakeApp, 221
Fake detection, 147
Fake news 2.0, 221
Far Cry and GTA, 216
Fashion shopping assistant, 112
FastCompany, 169
Fear, 217
Feedback data, 6
Feedback methods, 249
Fields of application of Artificial Intelligence, 22, 23, 87, 88
Fields of application of the digital personal assistants, 118
Filter bubble, 113
Financial services, 211
Five-step model, 12
Five-step model of decision automation, 13
Five Vs of big data, 64
Floating Point Operations Per Second (FLOPS), 79
Flow Machines, 218
Flying drones, 230
Forecasting purchasing behavior, 158
Forecasts for sales and demand, 100
Forecasts on the employment effects, 47
Forms of physical self-optimization, 75
Forms of self-optimization, 171
Four aspects of a message, 26
Four-ears model, 25
Four-sides model, 25–27
Fraunhofer Big Data Alliance, 246
Frequency trading, 214
Friends, 215
Fun applications, 144
Functionality of predictive policing, 229
Functional Magnetic Resonance Imaging (fMRI), 73
Future use of vehicles, 206

G
GAFA companies, 44
GAFAMI companies, 44, 129
Gartner hype cycle for new technologies, 70
Gartner's Emerging Technology Trends 2018, 71
General Data Protection Regulation (GDPR), 44, 67, 68, 282
General Electric, 92

Generalizability, 138
Generation R, 41
Generation robotic, 41
Gene scissors, 171
GiniMachine, 213
Glados, 216
Global AI race, 79
Global data flows and connectedness, 50
Go, 15
Google Assistant, 116
Google Home, 116
Google's ecosystem, 122
Google Translate, 24
Google translator, 222
GradeScope, 183
Guiding ideas of Design Thinking, 253

H
Hammer searches nail phenomenon, 244
"Handwriting"of artists, 215
Haptic glove, 78
Haptic jacket, 78
Hasso Plattner Institute, 179
Health apps, 178
HealthBox, 172
Health care, 167
Health/prevention kiosks, 177
Health-related information, 178
Heterogeneous Cooperating Team of Robots (*Hector*), 231
Hidden layer, 5
High-performance platforms, 95
H&M, 134
Holistic evaluation approach, 244
HoloLens, 185
HomePod, 116
Horizon-1 business models, 236
Horizon-1 level, 243
Horizon-2 business models, 237
Horizon-2 level, 244
Horizon-3 business models, 237
Horizon-3 level, 244
HOSPI, 176
Human augmentation, 76
Human Brain Project (HBP), 170
Human enhancement, 76
Human Genome Project, 170
Human horizon of knowledge, 35
Human-human communication, 30
Human intelligence, 2
Human resource management, 190
Human-machine communication, 30
Humanoid robots, 37, 38
Hype cycle for new technologies, 69

I
IBM, 200
IBM's Elderly Care, 200
IBM Watson, 112, 144, 172, 216
Ideates, 252
Identification of fake accounts, 148
Identification of unsafe content, 147
IHP, 201
Image processing, 22, 30
Image recognition, 144
Immersive experiences, 77
Implementation Phase, 259
Importance of smart manufacturing, 89
Importance of speech recognition, 24
Incremental optimizations, 237
Independent AI companies, 269
Indifferents, 111
Individualization of teaching in the classroom, 185
Individualized advertising, 156
Individualized medication, 171
Individualized medicine, 171, 177
Individualized promotion experience, 156
Individualized recommendations, 131
Individualized treatment plans, 177
Individual learning profile, 182
Industrial robots, 36, 97, 98
Industry 4.0, 88
Informational supply chain, 94
Injected chips, 76
Innovation centers, 269
Innovation engine, 269, 270
Innovation trigger, 69
Input data, 6
Input layer, 5
Input sciences, methods and application fields of Artificial Intelligence, 83
Integration of AI applications, 268
Intelligent logistics solutions, 205
Intelligent power grids, 195
Intelligent robots, 71
Intelligent Tutoring Systems (ITS), 180
Interactive screens, 156
Internal AI fields of action, 235
Internal image, 241
Internet of Everything, 63
Internet of Everything platforms, 74
Internet of Things (IoT), 62
Internet of Things platforms, 74
Intervention points, 128
Investments in Artificial Intelligence, 81
Iterative loops (iteration), 250
It's No Game, 215

J
Jeopardy, 15
Jobo, 187
Job placement, 282
Job search, 187
JPMorgan Chase, 212
Jukedeck, 218

K
Kik, 134
KLM Messenger, 112
Knowledge acquisition component, 34
Knowledge discovery, 8
Knowledge spillover effects, 51
Kuka, 93

L
Labor market, 53
Language-based dialog systems, 30
Language generation engine, 142
Law of the disproportionality of information, 68
Layers in neural networks, 5
Lead prediction, 130
Lead profiling, 130
Lean startup, 254
Lean startup method, 256
Lean startup model, 257
Learning robots, 184
Left for dead 2, 216
Legal framework, 282
Lethal autonomous weapon systems, 230
Lexus, 215
Lifelong learning, 182
Linguistic intelligence, 24
Location-based services, 135
Locations of the 500 most powerful supercomputers, 80
Logics of Artificial Intelligence, 219
Logistic robots, 203
Logistics, 155
Look-alike audiences, 130
Low Power Wide Area Network (LPWAN), 63
Lucy AI platform, 132
Lynda, 181

M
Machine learning, 5, 6
Machine learning canvas, 263, 264
Machine-like robots, 37
Machine-to-machine communication, 129
Macro factors, 48, 50
Maintenance logic, 161
Malteser, 200
Management of customer experience, 125
Management of education, 186
Management of hospital operations, 177
Marble, 208
Market penetration of digital personal assistants, 118
Mass customization, 93
Massive Open Online Courses (MOOCs), 180
Matrix production, 93
Mechanical reproduction of human intelligence, 14
Medical data for AI application, 167
Medical fields of application of Artificial Intelligence, 168
Medical robots, 36
Messaging application, 134
Messenger platforms, 143
Methods of agile product management, 244
Micro drones, 230
Micro factors, 48
Microsoft, 218
Microsoft Azure, 156, 247, 268
Military sector, 230
Minimum Viable Product (MVP), 255
MoBerries, 189
Mobile first, 124
Mobile robots, 36
Mobility and transportation sector, 205
Mobility as a Service (MaaS), 206
Modelling of target dialogs, 126
Modular system, 93
Monitoring of communication in the social media, 136
Monopolies Commission, 140
Moodle, 179
Moore's Law, 60
Must do applications, 279

N
Named Entity Recognition (NER), 29
National Grid, 196
National language processing, 27
Natural image processing, 30
Natural Language Processing (NLP), 24, 27
Natural Language Understanding (NLU), 25, 27
Navigation robot, 36
Near-repeat theory, 228
Need to do applications, 279
Negative competition effects, 50
Negative external distribution effects, 52
Negative externalities, 52
Nespresso Prodigio Titan machine, 164
Net effect on total employment, 53

Net Promoter Score (NPS), 110
Neural computing, 8
Neuralink, 73
Neural networks, 4
Neuro computing, 8
Neuro-technological implants, 19
New business models, 163
Newsroom concept, 149, 150
Next best action, 131
Next product to buy, 131
Number of private users of digital personal assistants, 118

O
One-to-one creation of books, 217
Online talent platforms, 187
Open AI project, 279
OpenSuperQ, 80
Optimization of business processes, 99
Optimized discounts, 156
Output layer, 5

P
Painting of Artificial Intelligence, 219
Panasonic, 176
Paraphrase, 28
Pareto channels, 126
Pareto dialogs, 126
Pareto tasks, 126
Parsing, 28, 29
Partial decisions, 12
Participation in an external data ecosystem, 242
Partnership on Artificial Intelligence, 246
Part-of-Speech tagging (POS-tagging), 29
Patient data cycle, 175
Pattern recognition, 130
Patterns, 215
Pay-as-you-go, 163
Pay-per-use, 163
Peak of inflated expectations, 69
People search in social media, 147
Performance components of Artificial Intelligence, 4
Performance engine, 268, 269
Performance gap on a company level, 47
Personal health managers, 172
Personalized training recommendations, 172
Personnel planning, 186
Phase 1: comprehensive information gathering, 242
Phase 2: systematic preparation of AI deployment, 245
Phase 3: development of AI applications, 248
Phase concept for the integrating chatbots and digital assistants into customer service, 125
Phase concept of the AI journey, 242
Phase of the lifecycle, 69
Phases of convergence, 249
Phases of divergence, 249
Phases of the Design Thinking process, 251
Phone call with a chatbot, 115
Photomontage, 220
Physical and digital value chains, 94
Plateau of productivity, 70
Platform canvas, 265, 266
Platform for image and video analysis, 146
Polarization of the labor market, 47
Porn industry, 178
Portal, The, 124
Post-Session, 263
Power-by-the-hour, 163
Power grid, 196
Precire, 109
Precire Technologies, 109
Prediction, 3
Prediction of fraudulent behavior, 213
Predictive analytics, 130
Predictive analytics for police work, 228
Predictive maintenance, 100, 161, 162, 164
Predictive maintenance model, 162
Predictive maintenance results, 163
Predictive maintenance steps, 161
Predictive policing, 228
Predictive servicing, 164, 165
Pre-launch, 255
Pre-launch phase, 256
Preloading rules, 9
Preparation of a change management, 242
Prerequisites for a successful AI integration, 242
Prescription, 3
Price-setting algorithms, 140
Prisma, 220
Proactive preventive medicine, 177
Processing node, 5
Process innovations, 49
Process steps of Design Thinking, 250
Procurement, 155
Procurement management, 100
Product and service innovations, 49
Production changes, 88
Professional training sector, 185
Programmatic brand promotions, 156
Promoters, 110
Promotion management, 155
Promotions, 156

Prostheses, 19
Prototype, 252

Q
Qualifying, 182
Quality transmissions, 215
Quantum computing, 60, 79
Quantum technology, 80

R
Rapid prototyping, 250, 252, 255, 260
Rational choice approach, 229
RealDoll, 178
Real-time instructions, 143
Reception robots, 40
Recognition of personalities, 147
Recommendation algorithms, 131
Recommendation engine, 130, 131
Regulatory necessity, 283
Reinforcement learning, 7
Relation extraction, 28
Relationship, 26
Rembrandt, 219
Remote diagnosis of the health status of patients, 177
Re-qualifying, 182, 183
Reshoring, 101
Reshoring Index, 101
Re-skilling initiative, 281
Resolution of the organizational dilemma, 269
Retail value chain, 155
Revenues from Artificial Intelligence, 2
Risk of collusive behavior, 141
Risks associated with the use of AI in military equipment, 232
ROBIN, 213
Robo advisors, 213
Robot journalism, 141
Robotic journalism, 142
Robotic natives, 41
Robotic Process Automation (RPA), 212
Robotics/robots, 36
Robot-recruiting, 190
Robots, 23, 36, 71
Robots in hospital logistics, 176
Robot-supported process automation, 23
ROI from digital factories and digital concepts, 89
Russia, 45

S
Scalability, 138
School cloud, 179
Scope for innovative business models, 283
Scoring procedure, 227
Second health market, 178
Security sector, 225
Self-adaptive algorithms, 6
Self-control over the learning process, 181
Self-image, 241
Self-learning ability, 17
Self-programming robots, 97
Self-revelation, 26
Semantic parsing, 28
Semantics, 28
Senior care, 200
Sensei, 139
Sensetime, 33, 144, 229
Sensor economy, 63
Sentiment analysis, 28, 136–138
Sentiment preferences, 160
Service platform, 201
Service robots, 36, 41, 199
Service sector, 107, 116
Sets for self-chipping, 77
Sexbots, 179
Shelf prices can be updated in real-time, 157
Siemens, 92
Simultaneous Localization and Mapping (SLAM), 40
Siri, 24, 116, 123
Slepper apps, 135
Slope of Enlightenment, 70
Smart cities, 202, 204
Smart factories, 88, 89
Smart grid initiatives, 195
Smart home, 197
Smart home applications, 197
Smart manufacturing, 89
Smart manufacturing market, 90
Smart meters, 195
Smart mobility, 203
Smartphone-controlled shoes, 172
Smart recommendations, 156
Smart terror, 202
Smart traffic, 203
Smart wires, 196
SnapTravel, 112
SO1, 156
Social bots, 30, 114
Social engineering, 108
Social engineers, 108
Social hacking, 109
Social listening, 136
Social scoring system, 226
Social, political, ecological and economic implications, 20
Sock puppet, 148

Sound spectrogram, 108
Speaker authentication, 107
Speaker recognition, 107, 108
Speaker verification, 107
Speech-based dialog systems (STS), 115
Speech recognition, 24
Speech-to-Speech (STS), 24
Speech-to-Text (STT), 24
Sputnik moment, 15
State investment support, 283
Stationary robots, 36
Status quo of the use of Artificial Intelligence, 24
Stiftung Warentest, 214
Stock management/parts management, 100
Store beacon technology, 157
Storytelling, 250
Strategic qualification gap, 182, 183
Strategic window of opportunity, 235
Streams, 174
Strong Artificial Intelligence, 17
Style transfer, 218, 219
Subscription model for heat, 200
Substitution, 49
Substitution of work, 49
Supercomputers, 79, 80
Super intelligence, 17, 18
Supervised learning, 6
Supply chain management, 100
Supply-demand fit, 254
Surveillance Capitalism, 68
Symbol of a higher level, 32
Syntactic parsing, 28
Syntax, 28
Systems of integrated value chains, 95

T
Table tops, 156
Tagging, 31
Tailor-made training proposals, 109
Talanx, 109
Tay, 113
Technological singularity, 20
Technological trends, 71
Telemedicine, 201
TensorFlow, 221
TeraFLOPS, 79
Test-and-learn approach, 244
Test and prototype mentality, 248
Text-based communication interface, 111
Text-based dialog systems, 30
Text categorization, 28
Textio, 189
Text mining, 137
Text-to-machine, 133
Text-to-Speech (TTS), 25
Text-to-Text (TTT), 25
Text-to-video technology., 144
Thief—The dark Project, 216
Thought control, 74
Time horizons of possible AI developments, 275, 276
Time-to-market, 255
Time-to-market approach, 254
Time-to-value, 118, 255, 256
Tonality of a statement, 137
Tonality of the dialogs, 126
Toy robots, 36
Trade-off between traceability and precision, 20
Training agenda, 186
Training data, 6
Transhuman, 75
Transhumanism, 19, 76
Transition and implementation costs, 52
Translation programs, 222
Transparency of algorithms, 11
Transparency of data, 11
Transparency of data delivery, 12
Transparency of decision-making processes in AI systems, 11
Transportation as a Service (TaaS), 206
Travel advice, 112
Trend analysis concerning “animal testing” using *ArgumenText*, 139
Troll factories, 148
Trolley problem, 20
Trough of disillusionment, 70
Trumpf, 92
T-Shape personalities, 249
TÜV NORD, 163
Two-sided markets, 266
Types of learning, 6

U
UA Record, 172
Ubiquitous infrastructure, 78
U-boat drones, 230
Uncanny valley, 39
Under Armour, 172
Unmanned submarines, 230
Unruly, 215
Unsupervised learning, 7
Uploading, 19
Upshifting, 19
USA, 46

Use case of *ArgumenText*, 138
User acceptance of autonomous driving, 207
User Test, 260

V
Value, 65, 66
Value-added potential of Artificial Intelligence in various industries, 277
Value instance integrated into the AI application, 114
Value-oriented customer management, 131
Values for the AI basics, 240
Values to the AI application fields, 241
Value systems, 95
Variety, 65, 66
Velocity, 65
Veracity, 66
Verified decisions, 13
Video surveillance, 226
Viessmann, 200
Virtual agents, 177
Virtual care robot, 175
Virtual health agent, 175
Virtual Manufacturing Execution System platform (VMES), 92
Virtual nurses, 175
Virtual personal agents, 155
Virtual personal assistants, 71
Virtual Reality (VR), 185
Virtual supervisor, 184
Visual arts, 219
Visual intelligence, 31
Vitronity, 217
VivoKey, 77
VoCo, 219
Voice analytics, 109
Voice content, 135
Voice Engine Optimization (VEO), 121, 129
Voice first, 121, 135
Voice only, 135
Voice prints, 108
Voice processing, 22
Voice-to-machine, 133
Volume, 65

W
Wandelbots, 11
Watson, 15
Watson for Oncology, 168
Watson Health, 168
Weak Artificial Intelligence, 17
Wealth creation and reinvestment, 51
Wealthfront, 214
Weapons technology, 230
Web monitoring, 136
Wellness online ecosystem, 172
Westworld, 179, 217
Wibbitz, 144
Width of the model, 6
Willingness to communicate with a chatbot, 114
Winner takes it all phenomenon, 266
Wise Athena, 140
Wordsmith Platform, 142
Workflow automation, 212
Workplace effects of AI use, 282

X
X as a service, 78
XiaoIce, 218

Y
Yield Optimization, 100

Z
Zalando, 53
Zalando App, 157
ZenCity, 203
Zuboff, 68
Zuckerberg's Law, 67